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The use of samarium or sodium iodide salts as an alternative for the aza-Henry reaction

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ABSTRACT

A novel reaction of bromonitromethane with a variety of imines in very mild conditions promoted by SmI_2 and NaI to afford nitroamines or bromonitroamines is described. When these reactions were performed on sugar-based imines, the corresponding nitroamines or bromonitroamines were obtained in high yields and from moderate to good stereoselectivities. Synthetic possibilities of nitroamines were also shown by their reduction with SmI_2/H_2O in the presence of pyrrolidine at room temperature. A mechanism is proposed for this novel aza-Henry reaction.

1. Introduction

The aza-Henry reaction, also called nitro-Mannich reaction, involves the nucleophilic addition of nitroalkanes to imines and is of prime importance for the synthesis of nitrogen-containing molecules. This reaction results in the formation of a carbon–carbon bond with concomitant generation of a β-nitroamine. From a synthetic point of view, this method presents important synthetic applications as a wide variety of other organic compounds can be accessed by functional transformations of the nitro group into other chemical functionalities, such as amines, [1] carbonyl groups,[2] hydroxylamines,[3] and oximes or nitriles,[4] providing access to valuable functionalized structural motifs such as 1,2-diamines.[5]

As the aza-Henry reaction has long been known,[6] it is understandable that significant efforts have been devoted over the years to improve the yields and stereocontrol of the process. Surprisingly, no significant success has been achieved until the last few years. Unlike the addition of nitronates to aldehydes, the addition to imines is thermodynamically not favored. On the one hand, Anderson et al. reasoned that, as nitronates are quite inert toward Schiff bases, the aid of a Lewis or Brønsted acid is required, reporting an improved version of the classical nitro-Mannich reaction.[7] On the other hand, Shibasaki et al. described in 1999 the first asymmetric aza-Henry reaction, in which binaphtoxide (BINOL)-based heterobimetallic complexes of ytterbium and aluminum were used as catalysts.[8]

Since Anderson and Shibasaki pioneering works, the aza-Henry reaction has attracted considerable chemical attention. So far, both racemic and asymmetric methods for the reactions with various nitroalkanes were realised using inorganocatalysts,[9] organocatalysts,[10] or chiral Lewis acid catalysts of ytterbium,[8] aluminum,[11] copper,[12] and zinc[13] metals.

Previously, we have described two addition reactions of bromonitromethane to aldehydes to give nitroalkan-2-ols[14] or 1-bromo-1-nitroalkan-2-ols.[15] These transformations took place under very mild reaction conditions and were promoted by samarium diiodide or sodium iodide, respectively. Both Henry reactions could be applied to the preparation of enantiopure compounds, starting from chiral *N*,*N*-dibenzyl aminoaldehydes. Thus, enantiopure (2*R*,3*S*)-3-amino-1-nitroalkan-2-ols or (1*S*,2*S*,3*S*)-3-amino-1-bromo-1-nitroalkan-2-ols were obtained with good stereoselectivity.

Herein we report our results concerning the addition of bromonitronate to a wide range of aldimines being the process promoted by catalytic amounts of sodium iodide to afford 1-bromo-1-nitroalkan-2-amines in nearly quantitative yields. Alternatively, the synthesis of 1-nitroalkan-2-amines can be achieved by using substoichiometric amounts of samarium diiodide or triiodide. Preparation of nitroamines or bromonitroamines derived from sugars is also reported. This transformation took place from moderate to good stereoselectivities and in absence of epimerization.

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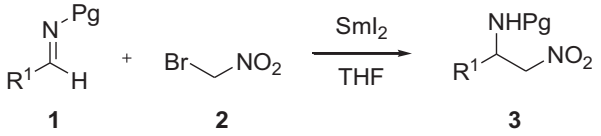
Imines **1** derived from *p*-toluenesulfonamide, and used as starting materials, were prepared in high yields according to a method previously reported in the literature.[16] Initially, we studied the addition reaction of bromonitromethane **2** to imines **1** promoted by samarium diiodide. Thus, the treatment of a solution of bromonitromethane **2** (1 equiv) and the *N*-tosylimine **1a** (1 equiv) in THF with a solution of 0.35, 0.5, and 1.0 equiv of SmI_2 in THF (0.1 M)[17] at room temperature gave in all cases the corresponding compound **3a**. The best results, in terms of yield (96% yield) and cleanliness of the crude material, were obtained using 1.0 equiv of SmI_2. When 0.35 or 0.5 equiv of SmI_2 were utilized, 69 and 87% yield of **3a** were obtained, respectively. For this reason entries shown in Table 1 were carried out using 1 equiv of SmI_2 for 5 h at room temperature.

Table 1
Synthesis of 2-amino-1-nitroalkanes **3**



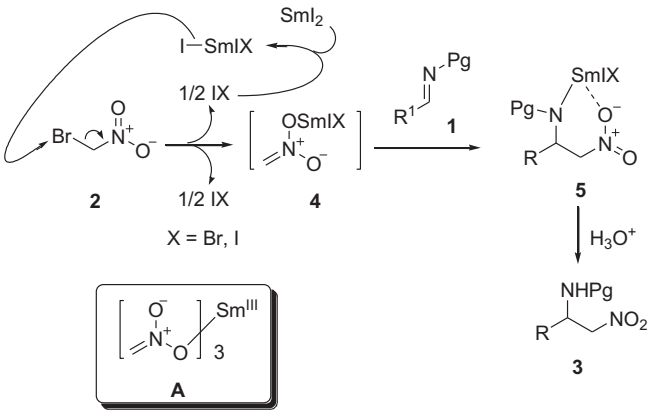
1 **2** **3**

Entry	1	3	R^1	Pg	Yield[a] (%)	
					SmI_2	SmI_3
1	**1a**	**3a**	*n*-C_7H_{15}	Ts	96	89
2	**1b**	**3b**	*s*-Bu	Ts	95	83
3	**1c**	**3c**	*c*-C_6H_{11}	Ts	88	77
4	**1d**	**3d**	$PhCH_2CH_2$	Ts	89	78
5	**1e**	**3e**	Ph	Ts	56	
6	**1f**	**3f**	*p*-CNC_6H_4	Ts	58	
7	**1g**	**3g**	*n*-C_7H_{15}	PMP	92	
8	**1h**	**3h**	*i*-Pr	PMP	90	
9	**1i**	**3i**	*s*-Bu	PMP	87	
10	**1j**	**3j**	*c*-C_6H_{11}	PMP	87	
11	**1k**	**3k**	$C_{10}H_{19}$[b]	PMP	84	
12	**1l**	**3l**	Ph	PMP	64	
13	**1m**	**3m**	*p*-CNC_6H_4	PMP	61	
14	**1n**	**3n**	Ph	BOC	65	
15	**1o**	**3o**	*p*-CNC_6H_4	BOC	60	
16	**1p**	**3p**	*p*-$MeOC_6H_4$	BOC	67	

[a] Isolated yield of analytically pure compounds **3**.
[b] (*E*)-EtCH=CH$(CH_2)_5$.

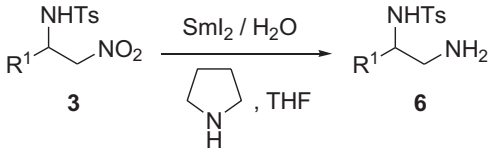
It is also worth of mention the use of substoichiometric amounts of SmI_2 to generate a nitronate intermediate. To explain these results, a mechanism based on the typical SmI_2 role as monoelectronic reducing agent in a Barbier-type process through the metalation of the C–Br bond should be discarded, as 2 equiv of SmI_2 would be required. We then assume that the synthesis of compounds **3** could be initiated by the iodide released from the SmI_3 traces, which are present in the THF solutions of SmI_2 (Scheme 1).[14,18] Thus the iodide would attack to the bromine atom of bromonitromethane generating a samarium (III) nitronate anion **4** and IBr. The addition of **4** to the imine would generate the samarium β-nitroamide **5** that would afford compounds **3** after hydrolysis. The employment of lower amount of SmI_2 (0.35 or 0.5 equiv) could be explained taking into account that the samarium alcoholate **4** might also act as a source of halogen (iodide or bromide). So, after two additional halogen-release, species such as the samarium *tris*-nitronate **A** could be generated affording compounds **5**, which, after hydrolysis yielded nitroaldol compounds **3**. A proof of this proposed mechanism is based on the synthesis of products **3a**–**d** in high yields using SmI_3 instead of SmI_2 (Table 1, entries 1–4).

The obtained 2-amino-1-nitroalkanes **3** can be versatile starting materials due to their high functionality. Attempts to deprotect the tosyl group were carried out on substrates **3a**, **3c**, and **3d** under the conditions previously reported by Hilmersson and Anker (SmI_2/H_2O in the presence of pyrrolidine at room temperature).[19] To our surprise, when these conditions were employed, 1,2-diaminoalkanes were obtained in high yields (Table 2) and no nitroamines were isolated.[20]



Scheme 1. Proposed mechanism for the synthesis of compounds **3**.

Table 2
Synthesis of 1,2-diaminoalkanes **6**



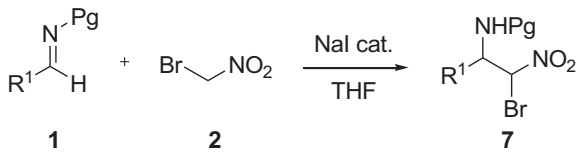
3 **6**

Entry	3	6	R^1	Yield[a] (%)
1	**3a**	**6a**	*n*-C_7H_{15}	89
2	**3c**	**6b**	*c*-C_6H_{11}	83
3	**3d**	**6c**	$PhCH_2CH_2$	77

[a] Isolated yield of analytically pure compounds **6**.

Taking into account both, the synthetic possibilities of an activated C-halogen bond and our previous report on the synthesis of 1-bromo-1-nitroalkan-2-ols,[15] we also tested the utilization of sodium iodide as a catalytic reagent for the synthesis of 1-bromo-1-nitroalkan-2-amines. Accordingly, when a solution of a variety of aldimines **1** (1.0 equiv) in THF and 1.0 equiv of bromonitromethane **2** were treated with 0.15 equiv of sodium iodide at room temperature for 3 h, 2-amino-1-bromo-1-nitroalkanes **7** were obtained in high yields (Table 3).

Table 3
Synthesis of 2-amino-1-bromo-1-nitroalkanes **7**



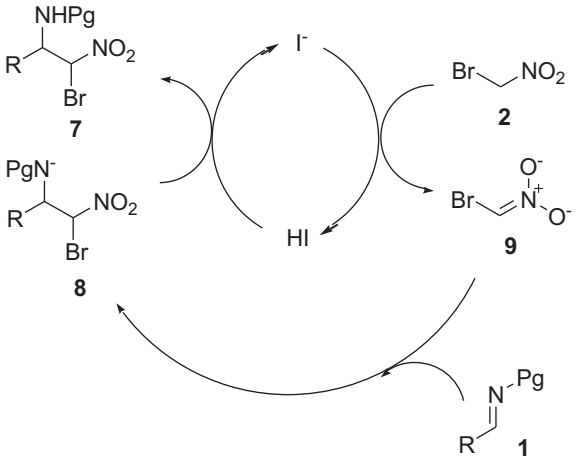
1 **2** **7**

Entry	1	7	R^1	Pg	Yield[a] (%)
1	**1a**	**7a**	*n*-C_7H_{15}	Ts	98
2	**1b**	**7b**	*s*-Bu	Ts	98
3	**1c**	**7c**	*c*-C_6H_{11}	Ts	94
4	**1d**	**7d**	$PhCH_2CH_2$	Ts	99
5	**1j**	**7e**	*c*-C_6H_{11}	PMP	94
6	**1n**	**7f**	Ph	BOC	63
7	**1o**	**7g**	*p*-CNC_6H_4	BOC	60
8	**1p**	**7h**	*p*-$MeOC_6H_4$	BOC	65

[a] Isolated yield after filtration or column chromatography based on compounds **1**.

In general terms, crude reaction products were obtained in high purity, after filtration through a pad of Celite and further solvent removal under vacuum. No column chromatography purification was necessary to obtain compounds **7a**–**e** excepting **7f**–**h** (derived from aromatic imines). Compounds **7** were isolated with high purity and as a mixture of diastereoisomers in approximately 1:1 ratio, determined by ^{1}H analysis of the crude reaction products (Table 3).

This transformation took place based, on one hand, due to the high acidity of bromonitromethane **2** and, on the other hand, taking into account that although the iodide is a very weak base in an aqueous medium, in THF could be sufficiently strong to abstract an acidic proton from bromonitromethane. Thus, an acid–base reaction of bromonitromethane with the iodide anion could generate a bromonitronate intermediate **9** that could react with aldimines **1** to afford the amides **8**, which after protonolysis with the in situ generated hydrogen iodide would generate the corresponding bromonitroamine **7** releasing the iodide anion that would continue the catalytic system (Scheme 2).



Scheme 2. Proposed mechanism for the synthesis of compounds **7**.

The different behavior of the iodide atoms depending on their cationic partner (Sm^{+2} or Sm^{+3} in comparison with Na^+) could be rationalized considering the ionic (Na^+) or covalent (Sm^{+3}) character of these species. So, iodide from NaI could be completely dissociated and could abstract acidic hydrogens, whereas iodide from Sm^{+3} species would be partially bonded to the samarium center decreasing the basic properties of these iodide ions.

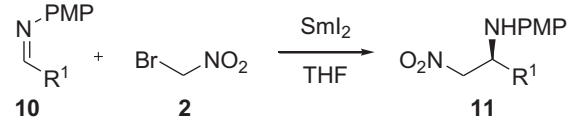
In general terms, as it can be envisaged in Tables 1 and 3, it is noteworthy that: (1) the addition reaction of bromonitronate intermediate to aldimines was not reported to date and constitutes an interesting synthetic method due to the low cost of the catalyst used. (2) The unreported use of substoichiometric amounts of samarium di- or triiodide to promote the aza-Henry reactions from a wide range of aldimines is an attractive synthetic methodology to choose due to its high efficiency and the quantitative yields obtained. (3) The addition reaction of the samarium nitronate or sodium bromonitronate to imines seems to be general as it was proved by performing the reaction from aliphatic (linear, cyclic, or branched) or aromatic (electron rich or deficient) aldimines **1** as starting materials. (4) 2-Amino-1-nitroalkanes **3** and 2-amino-1-bromo-1-nitroalkanes **7** were obtained in very high yields. (5) In both syntheses, the reaction has also been carried out on *N*-(*p*-methoxyphenyl)imines **1g**–**m**[21] (Table 1, entries 7–13; Table 3, entry 5), and *N*-Boc imines **1n**–**o** (Table 1, entries 14–16; Table 3, entries 6–8) and no important differences were observed when compared with the reaction of *N*-tosylimines **1a**–**f** excepting the case of aromatic aldimines **1l**–**p** where slightly higher yields were obtained. (6) Other iodide sources different than SmI_2 and NaI, such as SmI_3 and LiI or KI could be used to perform both aza-Henry reactions. As it can be envisaged in Table 1, slightly lower yields of compounds **3** were obtained (entries 1–4) when SmI_3 was employed instead of SmI_2. On the other hand longer reaction time was required (18 h) in the reactions promoted by LiI or KI affording the corresponding compound **7a** (from **1a**) in similar yields to those obtained using NaI (Table 3).

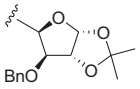
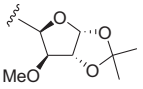
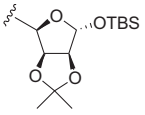
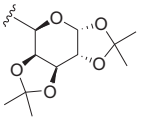
The satisfactory results obtained in the synthesis of racemic nitro amines **3** and bromonitroamines **7** prompted us to test the usefulness of this methodology for the synthesis of chiral sugar-derived enantiopure diamines.

Chiral enantiopure diamines are useful synthetic intermediates and are of great interest for the development of new chiral ligands for asymmetric synthesis. Particularly appropriate for these purposes are 1,2-diamines containing a sugar residue.[22]

Our studies were carried out with *N*-*p*-methoxyphenylimines **10**, which upon reaction with bromonitromethane (1.0 equiv) and SmI_2 in THF (1.0 equiv, 0.1 M) provided the corresponding nitro amines **11** in high yields and diastereoisomeric ratio ranging between 5/1 and 2/1 (Table 4).

Table 4
Synthesis of carbohydrate-derived aminonitroalkanes **11**



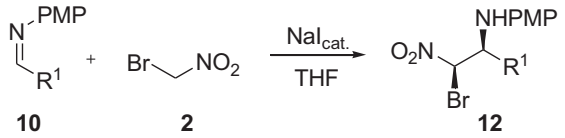
Entry	10	11	R^1	dr[a]	Yield[b] (%)
1	**10a**	**11a**		5/1	90
2	**10b**	**11b**		4/1	86
3	**10c**	**11c**		2.5/1	81
4	**10d**	**11d**		2/1	76

[a] dr was determined by 300 MHz ^{1}H NMR analysis of the crude products **11**.
[b] Isolated yield of pure compounds **11** after column chromatography based on compounds **10**.

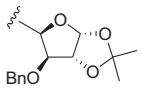
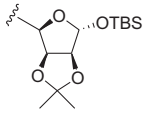
In subsequent experiments aimed at extending these studies to include the preparation of sugar-derived 1-bromo-1-nitroalkan-2-amines, we also tested the utilization of sodium iodide as a catalytic reagent. Thus, reaction of the *N*-*p*-methoxyphenylimines **10a** and **10c**, with bromonitromethane (1 equiv) and NaI (0.15 equiv) in THF provided the corresponding bromonitroamines **12** in high yields and moderate diastereoisomeric ratio. When the reaction was performed at lower temperatures (0 °C), no differences were observed on the stereoselectivity of this process (Table 5).

The absolute configuration of the major stereoisomer 1-bromo-1-nitroalkan-2-amine **12a** was established by X-ray diffraction (Fig. 1).[23] The structure and the absolute configuration of 1-bromo-1-nitroalkan-2-amine **12b** were assigned by analogy.

Table 5
Synthesis of carbohydrate-derived bromonitroamines **12**



10 **2** **12**

Entry	10	12	R^1	dr[a]	Yield[b] (%)
1	**10a**	**12a**		2.5/1	83
3	**10c**	**12b**		1.5/1	72

[a] dr was determined by 300 MHz ^{1}H NMR analysis of the crude products **12**.
[b] Isolated yield of pure compounds **12** after column chromatography based on compounds **10**.

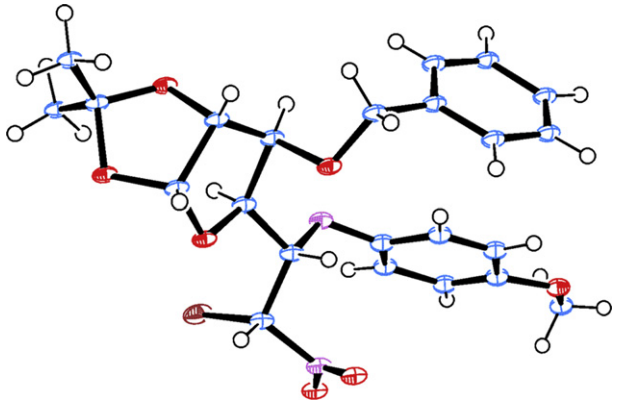
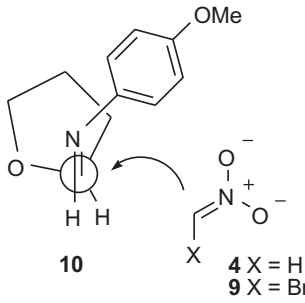


Fig. 1. Ortep diagram for **12a**.

It is noteworthy that no significant differences were observed on the reaction of *N*-*p*-methoxyphenylimines derived from carbohydrates **10** when compared with the reaction of *N*-*p*-methoxyphenylimines **1g**–**m**.

The stereoselectivity obtained in the addition of bromonitromethane **2** to imines **10** can easily be explained through the Felkin–Ahn model; the nitronate (X=H) or bromonitronate (X=Br) attack on the *si* face giving preferentially to the *anti*-stereoisomers (Scheme 3).[24] This mechanistic proposal was confirmed by X-ray diffraction of compound **12a** (Fig. 1).



Scheme 3. Mechanism for the addition of nitronates to sugar-derived imines **10**.

In conclusion, we have described a novel reaction of bromonitromethane with a variety of imines in very mild conditions promoted by SmI_2 and NaI to afford nitroamines or bromonitroamines, respectively. Regarding the stereoselective version of this novel approach to 2-nitro amines, promising results were achieved when chiral sugar-derived imines **10** were reacted with bromonitromethane in the presence of both, SmI_2 and NaI. The chiral 2-nitroamines **11** and **12** obtained were those predicted by the Felkin–Ahn model. Other synthetic applications of these reactions and studies directed toward fully delineating the factors involved in these transformations are currently under investigation.

2. Experimental section

2.1. General procedures for the synthesis of imines (1)

*2.1.1. Synthesis of N-tosylimines (**1a**–**f**).* A mixture of the corresponding aldehyde (10.0 mmol, 1.0 equiv), *p*-toluenesulfonamide (10.0 mmol, 1.0 equiv), sodium *p*-toluenesulfinate (10.0 mmol, 1.0 equiv) in formic acid (95%, 15 mL), and H_2O (15 mL) was stirred for 24 h at room temperature. The resulting white precipitate was collected by filtration, washed with H_2O (3×10 mL), and hexane (2×10 mL), then dissolved in CH_2Cl_2 (100 mL), followed by addition of H_2O (35 mL) and aqueous saturated solution of $NaHCO_3$ (35 mL). The solution was then stirred for 10 min at room temperature. The organic phase was collected, and the aqueous phase was extracted with CH_2Cl_2 (3×70 mL). The combined organic layers were dried over $NaSO_4$, concentrated to yield the corresponding *N*-sulfonyl imine as a colorless oil or white solid. Aliphatic imines were used without further purification, and aromatic imines were purified by trituration with water and hexane.

*2.1.2. Synthesis of N-(p-methoxyphenyl)imines (**1g**–**m**).* The aliphatic *p*-methoxyphenylimines **1g**–**j** were prepared in nearly quantitative yields by stirring for 2 h a solution in CH_2Cl_2 of the corresponding aldehyde (10 mmol, 1.0 equiv) with *p*-anisidine (10 mmol, 1.0 equiv) in the presence of $MgSO_4$ (2 g). For the synthesis of aromatic imines **1k**–**m**, the reaction time was increased to 16 h. Compounds **1k**–**m** were purified by recrystallization in ethanol.

*2.1.3. Synthesis of N-tert-butoxycarbonylimines (**1n**–**p**).* Compounds **1n**–**p** were prepared following the method previously described in the literature.

*2.1.4. Synthesis of 2-amino-1-nitroalkanes (**3**).* SmI_2 or SmI_3 (0.8 mmol, 1 equiv) in THF (8 mL) was added to a stirred solution of bromonitromethane **2** (0.8 mmol, 1 equiv) and the corresponding imines **1** (0.8 mmol, 1 equiv) in THF (5 mL). After stirring the reaction mixture at room temperature for 5 h it was quenched with aqueous HCl (10 mL, 0.1 M) and then, the organic material was extracted with dichloromethane. The combined extracts were washed with an aqueous saturated solution of $Na_2S_2O_3$, then dried over Na_2SO_4, and the solvents were removed under reduced pressure affording compounds **3**, which were purified by column chromatography (hexane/EtOAc 3:1).

*2.1.4.1. 1-Nitro-N-tosylnonan-2-amine (**3a**).* Yellow solid; mp 134–137 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.79 (d, J=8.4 Hz, 2H), 7.33 (d, J=8.4 Hz, 2H), 5.48 (d, J=8.5 Hz, 1H), 4.51 (dd, J=12.7, 5.2 Hz, 1H), 4.39 (dd, J=12.7, 5.8 Hz, 1H), 3.83–3.72 (m, 1H), 2.44 (s, 3H), 1.53–1.40 (m, 2H), 1.29–0.98 (m, 10H), 0.86 (t, J=7.0 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.9 (C), 136.9 (C), 129.7 (2× CH), 127.0 (2× CH), 78.5 (CH_2), 51.6 (CH), 32.2 (CH_2), 31.4 (CH_2), 28.8 (CH_2), 28.6 (CH_2), 25.1 (CH_2), 22.4 (CH_2), 21.4 (CH_3), 13.9 (CH_3); MS (ESI$^+$)

m/*z* (%) 343 ([M+H]$^+$, 47), 283 (6), 282 (100), 128 (10); HRMS (ESI$^+$) calcd for [$C_{16}H_{27}N_2O_4S$]$^+$ [M+H]$^+$ 343.1692, found 343.1686; IR (neat): 3304, 1558, 1380, 1344, 1161 cm^{-1}; R_f=0.50 (hexane/EtOAc 3:1).

*2.1.4.2. 3-Methyl-1-nitro-N-tosylpentan-2-amine (**3b**).* Orange solid; mp 137–140 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.75–7.66 (m, 4H), 7.25–7.20 (m, 4H), 5.45 (d, *J*=9.0 Hz, 1H), 5.36 (d, *J*=8.7 Hz, 1H), 4.44–4.23 (m, 4H), 3.81–3.64 (m, 2H), 2.36 (s, 3H), 2.35 (s, 3H), 1.55–0.78 (m, 6H), 0.78–0.71 (m, 6H), 0.64 (t, *J*=7.3 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.9 (C), 143.4 (C), 139.0 (C), 136.7 (C), 129.7 (2× CH), 129.6 (2× CH), 127.0 (2× CH), 126.2 (2× CH), 76.7 (CH_2), 76.2 (CH_2), 56.0 (CH), 55.0 (CH), 37.0 (CH), 36.3 (CH), 25.4 (CH_2), 24.7 (CH_2), 21.5 (CH_3), 21.4 (CH_3), 14.7 (CH_3), 13.7 (CH_3), 11.1 (2× CH_3); MS (ESI$^+$) *m*/*z* (%) 318 ([M+Na]$^+$, 100), 301 ([M+H]$^+$, 47), 241 (4), 240 (66); HRMS (ESI$^+$) calcd for [$C_{13}H_{21}N_2O_4S$]$^+$ [M+H]$^+$ 301.1222, found 301.1216; IR (neat): 3379, 1558, 1380, 1266, 1164 cm^{-1}; R_f=0.36 (hexane/EtOAc 3:1).

*2.1.4.3. 1-Cyclohexyl-2-nitro-N-tosylethanamine (**3c**).* Yellow solid; mp 135–137 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.69 (d, *J*=8.1 Hz, 2H), 7.25 (d, *J*=8.1 Hz, 2H), 5.21 (d, *J*=9.2 Hz, 1H), 4.42 (dd, *J*=13.1, 5.2 Hz, 1H), 4.30 (dd, *J*=13.1, 5.3 Hz, 1H), 3.60–3.52 (m, 1H), 2.73 (s, 3H), 1.70–1.34 (m, 5H), 1.15–0.68 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.9 (C), 137.1 (C), 129.7 (2× CH), 127.0 (2× CH), 76.2 (CH), 56.4 (CH), 39.6 (CH), 29.2 (CH_2), 28.4 (2× CH_2), 25.6 (2× CH_2), 21.5 (CH_3); MS (ESI$^+$) *m*/*z* (%) 327 ([M+H]$^+$, 64), 268 (6), 266 (100), 112 (4); HRMS (ESI$^+$) calcd for [$C_{15}H_{23}N_2O_4S$]$^+$ [M+H]$^+$ 327.1379, found 327.1373; IR (neat): 3259, 1556, 1385, 1266, 1162 cm^{-1}; R_f=0.40 (hexane/EtOAc 3:1).

*2.1.4.4. 1-Nitro-4-phenyl-N-tosylbutan-2-amine (**3d**).* Yellow solid; mp 136–138 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.68 (d, *J*=7.4 Hz, 2H), 7.25–7.09 (m, 5H), 6.89 (d, *J*=7.4 Hz, 2H), 5.48 (d, *J*=8.8 Hz, 1H), 4.39 (dd, *J*=12.9, 5.0 Hz, 2H), 4.30 (dd, *J*=12.9, 5.2 Hz, 1H), 3.77–3.66 (m, 1H), 2.57–2.47 (m, 2H), 2.36 (s, 3H), 1.80–1.69 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 144.0 (C), 139.7 (C), 136.9 (C), 129.9 (2× CH), 128.5 (2× CH), 128.1 (2× CH), 127.0 (2× CH), 126.2 (CH), 78.2 (CH_2), 51.1 (CH), 33.9 (CH_2), 31.4 (CH_2), 21.4 (CH_3); MS (ESI$^+$) *m*/*z* (%) 349 ([M+H]$^+$, 100), 288 (10), 214 (10), 196 (7), 149 (5); HRMS (ESI$^+$) calcd for [$C_{17}H_{21}N_2O_4S$]$^+$ [M+H]$^+$ 349.1222, found 349.1217; IR (neat): 3273, 1558, 1381, 1334, 1160 cm^{-1}; R_f=0.35 (hexane/EtOAc 3:1).

*2.1.4.5. 2-Nitro-1-phenyl-N-tosylethanamine (**3e**).* Yellow solid; mp 156–159 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.64 (d, *J*=8.8 Hz, 2H), 7.25–7.20 (m, 5H), 7.09 (d, *J*=8.8 Hz, 2H), 5.59 (d, *J*=7.6 Hz, 1H), 5.00 (apparent q, *J*=6.9 Hz, 1H), 4.82 (dd, *J*=13.1, 6.7 Hz, 1H), 4.66 (dd, *J*=13.1, 6.3 Hz, 1H), 2.40 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.9 (C), 136.4 (C), 135.2 (C), 129.7 (2× CH), 129.1 (2× CH), 128.9 (CH), 127.0 (2× CH), 126.4 (2× CH), 78.9 (CH_2), 55.4 (CH), 21.5 (CH_3); MS (ESI$^+$) *m*/*z* (%) 343 ([M+Na]$^+$, 100), 338 ([M+NH_4]$^+$, 42), 321 ([M+H]$^+$, 4), 260 (7); HRMS (ESI$^+$) calcd for [$C_{15}H_{17}N_2O_4S$]$^+$ [M+H]$^+$ 321.0909, found 321.0903; IR (neat): 3251, 1552, 1379, 1324, 1163 cm^{-1}; R_f=0.60 (hexane/EtOAc 1:1).

*2.1.4.6. 2-Nitro-1-p-cyanophenyl-N-tosylethanamine (**3f**).* Yellow solid; mp 160–162 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.69 (d, *J*=8.0 Hz, 4H), 7.56 (d, *J*=8.0 Hz, 4H), 5.55 (dd, *J*=8.1, 3.9 Hz, 1H), 4.62–4.50 (m, 2H), 2.03 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.3 (2× C), 132.7 (4× C), 132.4 (C), 126.7 (4× C), 118.2 (C), 112.6 (C), 80.7 (CH_2), 70.0 (CH), 21.0 (CH_3); MS (ESI$^+$) *m*/*z* (%) 368 ([M+Na]$^+$, 100), 346 ([M+H]$^+$, 12), 274 (6), 190 (5); HRMS (ESI$^+$) calcd for [$C_{16}H_{16}N_3O_4S$]$^+$ [M+H]$^+$ 346.0862, found 346.0855; IR (neat): 3449, 2232, 1558, 1378, 1266, 1163 cm^{-1}; R_f=0.62 (hexane/EtOAc 1:1).

*2.1.4.7. 4-Methoxy-N-(1-nitrononan-2-yl)benzenamine (**3g**).* Brown oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.80 (d, *J*=8.5 Hz, 2H), 6.64 (d, *J*=8.5 Hz, 2H), 4.51 (dd, *J*=11.5, 4.9 Hz, 1H), 4.41 (dd, *J*=11.5, 5.7 Hz, 1H), 3.98–3.87 (m, 1H), 3.75 (s, 3H), 1.71–1.27 (m, 12H), 0.88 (t, *J*=6.2 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 152.9 (C), 139.9 (C), 115.3 (2× CH), 115.0 (2× CH), 78.0 (CH_2), 55.6 (CH_3), 53.5 (CH), 32.8 (CH_2), 31.6 (CH_2), 29.2 (CH_2), 28.9 (CH_2), 25.8 (CH_2), 22.5 (CH_2), 13.9 (CH_3); MS (ESI$^+$) *m*/*z* (%) 295 ([M+H]$^+$, 100), 234 (5), 214 (4), 201 (7); HRMS (ESI$^+$) calcd for [$C_{16}H_{27}N_2O_3$]$^+$ [M+H]$^+$ 295.2022, found 295.2016; IR (neat): 3380, 1550, 1513, 1381, 1243 cm^{-1}; R_f=0.48 (hexane/EtOAc 5:1).

*2.1.4.8. 4-Methoxy-N-(3-methyl-1-nitrobutan-2-yl)benzenamine (**3h**).* Brown oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.79 (d, *J*=7.2 Hz, 2H), 6.64 (d, *J*=7.2 Hz, 2H), 4.48 (d, *J*=5.9 Hz, 1H), 4.12 (q, *J*=7.1 Hz, 1H), 3.89–3.74 (m, 2H), 3.70 (s, 3H), 1.29–1.23 (m, 1H), 1.03 (apparent t, *J*=7.0 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 152.8 (C), 140.3 (C), 115.2 (2× CH), 115.0 (2× CH), 76.5 (CH_2), 58.9 (CH), 55.7 (CH_3), 30.4 (CH), 19.0 (CH_3), 18.1 (CH_3); MS (ESI$^+$) *m*/*z* (%) 239 ([M+H]$^+$, 100), 232 (29), 208 (20), 176 (24); HRMS (ESI$^+$) calcd for [$C_{12}H_{19}N_2O_3$]$^+$ [M+H]$^+$ 239.1396, found 239.1390; IR (neat): 3402, 1554, 1512, 1382, 1242 cm^{-1}; R_f=0.53 (hexane/EtOAc 3:1).

*2.1.4.9. 4-Methoxy-N-(3-methyl-1-nitropentan-2-yl)benzenamine (**3i**).* Brown oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.76 (d, *J*=9.1 Hz, 2H), 6.75 (d, *J*=9.0 Hz, 2H), 6.65 (d, *J*=9.0 Hz, 2H), 6.64 (d, *J*=9.0 Hz, 2H), 4.70 (dd, *J*=12.5, 1.7 Hz, 1H), 4.67 (dd, *J*=12.3, 2.0 Hz, 1H), 4.45 (dd, *J*=12.5, 1.8 Hz, 1H), 4.43 (dd, *J*=12.3, 2.7 Hz, 1H), 4.15–4.05 (m, 2H), 3.72 (s, 6H), 1.74–1.48 (m, 2H), 1.28–1.23 (m, 4H), 1.20 (d, *J*=4.3 Hz, 6H), 0.95 (t, *J*=7.2 Hz, 3H), 0.88 (t, *J*=7.5 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 152.6 (2× C), 140.9 (C), 140.7 (C), 114.9 (4× CH), 114.8 (4× CH), 76.1 (CH_2), 75.9 (CH_2), 75.1 (CH), 74.7 (CH), 55.6 (2× CH_3), 32.1 (CH), 32.0 (CH), 23.3 (CH_2), 23.0 (CH_2), 8.0 (2× CH_3), 7.7 (2× CH_3); MS (ESI$^+$) *m*/*z* (%) 275 ([M+Na]$^+$, 100), 270 ([M+NH_4]$^+$, 47), 253 ([M+H]$^+$, 12), 209 (6), 206 (4); HRMS (ESI$^+$) calcd for [$C_{13}H_{21}N_2O_3$]$^+$ [M+H]$^+$ 253.1552, found 253.1548; IR (neat): 3410, 1555, 1513, 1380, 1247 cm^{-1}; R_f=0.53 (hexane/EtOAc 1:1).

*2.1.4.10. N-(1-Cyclohexyl-2-nitroethyl)-4-methoxybenzenamine (**3j**).* Brown oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.76 (d, *J*=9.0 Hz, 2H), 6.65 (d, *J*=9.0 Hz, 2H), 4.72 (dd, *J*=12.3, 5.2 Hz, 1H), 4.46 (dd, *J*=12.3, 7.4 Hz, 1H), 4.08–4.04 (m, 1H), 3.73 (s, 3H), 2.73 (s, 11H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 152.7 (C), 141.0 (C), 115.0 (2× CH), 114.9 (2× CH), 75.7 (CH_2), 60.9 (CH), 55.7 (CH_3), 43.0 (CH), 34.7 (2× CH_2), 25.2 (CH_2), 21.6 (2× CH_2); MS (ESI$^+$) *m*/*z* (%) 279 ([M+H]$^+$, 6), 234 (19), 216 (100), 214 (28); HRMS (ESI$^+$) calcd for [$C_{15}H_{23}N_2O_3$]$^+$ [M+H]$^+$ 279.1709, found 279.1703; IR (neat): 3389, 1553, 1513, 1384, 1243 cm^{-1}; R_f=0.22 (hexane/EtOAc 3:1).

*2.1.4.11. 4-Methoxy-N-[(Z)-1-nitroundec-8-en-2-yl]benzenamine (**3k**).* Brown oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 6.80 (d, *J*=7.2 Hz, 2H), 6.64 (d, *J*=7.2 Hz, 2H), 6.51 (d, *J*=7.1 Hz, 1H), 5.41–5.25 (m, 2H), 4.51 (dd, *J*=11.4, 5.3 Hz, 1H), 4.41 (dd, *J*=11.4, 5.4 Hz, 1H), 3.96–3.90 (m, 1H), 3.76 (s, 3H), 2.05–2.00 (m, 4H), 1.70–1.68 (m, 8H), 0.96 (t, *J*=7.1 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 139.8 (C), 138.5 (C), 131.8 (CH), 128.8 (CH), 115.4 (2× CH), 115.1 (2× CH), 78.0 (CH_2), 55.7 (CH_3), 53.5 (CH), 32.8 (CH_2), 29.4 (CH_2), 28.9 (CH_2), 26.8 (CH_2), 25.8 (CH_2), 20.5 (CH_2), 14.3 (CH_3); MS (ESI$^+$) *m*/*z* (%) 343 ([M+Na]$^+$, 100), 321 ([M+H]$^+$, 32), 301 (21), 274 (12), 213 (4); HRMS (ESI$^+$) calcd for [$C_{18}H_{29}N_2O_3$]$^+$ [M+H]$^+$ 321.2178, found 321.2172; IR (neat): 3402, 1553, 1514, 1381, 1242 cm^{-1}; R_f=0.53 (hexane/EtOAc 3:1).

*2.1.4.12. 4-Methoxy-N-(2-nitro-1-phenylethyl)benzenamine (**3l**).* Brown oil; ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.61–7.24 (m, 5H), 6.73 (d, *J*=9.0 Hz, 2H), 6.58 (d, *J*=9.0 Hz, 2H), 6.23 (d, *J*=7.4 Hz, 1H), 5.09 (t, *J*=6.7 Hz, 1H), 4.69 (d, *J*=6.7 Hz, 2H), 3.71 (s, 3H); ^{13}C NMR

(75 MHz, $CDCl_3$): δ 153.1 (C), 139.6 (C), 137.9 (C), 129.2 (2× CH), 128.5 (CH), 126.4 (2× CH), 115.6 (2× CH), 114.8 (2× CH), 80.0 (CH_2), 57.7 (CH), 55.6 (CH_3); MS (ESI^+) *m/z* (%) 273 ($[M+H]^+$, 4), 213 (7), 212 (100), 124 (7); HRMS (ESI^+) calcd for $[C_{15}H_{17}N_2O_3]^+$ $[M+H]^+$ 273.1239, found 273.1233; IR (neat): 3375, 1554, 1511, 1378, 1243 cm^{-1}; R_f=0.23 (hexane/AcOEt 3:1).

*2.1.4.13. 4-[1-(4-Methoxyphenylamino)-2-nitroethyl]benzonitrile (**3m**).* Brown oil; ^1H NMR (300 MHz, $CDCl_3$): δ 7.68 (d, *J*=8.3 Hz, 2H), 7.53 (d, *J*=8.3 Hz, 2H), 6.73 (d, *J*=9.0 Hz, 2H), 6.53 (d, *J*=9.0 Hz, 2H), 5.12 (t, *J*=6.4 Hz, 1H), 4.71 (d, *J*=6.4 Hz, 2H), 3.71 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 153.4 (C), 143.3 (C), 138.7 (C), 133.0 (2× CH), 129.3 (C), 127.4 (2× CH), 118.1 (C), 115.7 (2× CH), 114.9 (2× CH), 79.5 (CH_2), 57.3 (CH), 55.6 (CH_3); MS (ESI^+) *m/z* (%) 320 ($[M+Na]^+$, 100), 298 ($[M+H]^+$, 64), 212 (60), 186 (24); HRMS (ESI^+) calcd for $[C_{16}H_{16}N_3O_3]^+$ $[M+H]^+$ 298.1192, found 298.1188; IR (neat): 3388, 2230, 1556, 1512, 1378, 1240, cm^{-1}; R_f=0.20 (hexane/AcOEt 3:1).

*2.1.4.14. tert-Butyl 2-nitro-1-phenylethylcarbamate (**3n**).* White solid; mp 101–103 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.43–7.29 (m, 5H), 5.37–5.28 (m, 2H), 4.84–4.82 (m, 1H), 4.70 (dd, *J*=12.6, 5.6 Hz, 1H), 1.44 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 154.7 (C), 136.9 (C), 129.1 (2× CH), 128.6 (CH), 126.2 (2× CH), 80.6 (C), 78.8 (CH_2), 55.8 (CH), 28.1 (3× CH_3); MS (ESI^+) *m/z* (%) 289 ($[M+Na]^+$, 100), 233 (31), 150 (13), 102 (7); HRMS (ESI^+) calcd for $[C_{13}H_{18}N_2O_4Na]^+$ $[M+Na]^+$ 289.1164, found 289.1161; IR (neat): 3330, 1716, 1557, 1380, 1266 cm^{-1}; R_f=0.50 (hexane/AcOEt 3:1).

*2.1.4.15. tert-Butyl 1-(4-cyanophenyl)-2-nitroethylcarbamate (**3o**).* White solid; mp 100–102 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.67 (d, *J*=7.3 Hz, 2H), 7.46 (d, *J*=7.3 Hz, 2H), 5.86–5.61 (m, 1H), 5.51–5.32 (m, 1H), 4.84–4.74 (m, 2H), 1.41 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 154.6 (C), 142.3 (C), 132.8 (2× CH), 127.1 (2× CH), 118.1 (C), 112.4 (C), 81.0 (C), 78.2 (CH_2), 52.2 (CH), 28.1 (3× CH_3); MS (ESI^+) *m/z* (%) 314 ($[M+Na]^+$, 100), 285 (15), 210 (92), 131 (31), 110 (31); HRMS (ESI^+) calcd for $[C_{14}H_{18}N_3O_4]^+$ $[M+H]^+$ 292.1297, found 292.1293; IR (neat): 3350, 2231, 1689, 1557, 1369, 1251 cm^{-1}; R_f=0.30 (hexane/AcOEt 3:1).

*2.1.4.16. tert-Butyl 1-(4-methoxyphenyl)-2-nitroethylcarbamate (**3p**).* Yellow solid; mp 101–103 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.15 (d, *J*=8.8 Hz, 2H), 6.81 (d, *J*=8.8 Hz, 2H), 5.37–5.15 (m, 2H), 4.84–4.67 (m, 1H), 4.60–4.56 (m, 1H), 3.71 (s, 3H), 1.35 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.6 (C), 154.7 (C), 128.8 (C), 127.5 (2× CH), 114.4 (2× CH), 80.5 (C), 78.8 (CH_2), 55.5 (CH_3), 52.4 (CH), 28.1 (3× CH_3); MS (ESI^+) *m/z* (%) 297 ($[M+H]^+$, 24), 293 (100), 187 (34), 171 (50), 127 (45), 113 (29); HRMS (ESI^+) calcd for $[C_{14}H_{20}N_2O_5Na]^+$ $[M+Na]^+$ 319.1270, found 319.1279; IR (neat): 3327, 1677, 1557, 1370, 1266 cm^{-1}; R_f=0.35 (hexane/AcOEt 3:1).

*2.1.5. Synthesis 1,2-diaminoalkanes **6**.* To a solution of SmI_2 (0.1 M, 0.52 mmol, 10 equiv) in THF was added the sulphonamide (0.052 mmol, 1 equiv) followed by water (28 μL, 1.56 mmol) and pyrrolidine (90 μL, 1.04 mmol) under a nitrogen atmosphere. The reaction mixture immediately turned white upon addition of amine. The resulting mixture was diluted with diethyl ether (4 mL) and treated with a solution of potassium sodium tartrate and potassium carbonate (10% w/w each). The aqueous phase was extracted with two portions of diethyl ether. The organic extracts were pooled, dried, and evaporated to yield the crude amine. Analytically pure compounds **6** were obtained being unnecessary further purification.

*2.1.5.1. N^2-Tosylnonane-1,2-diamine (**6a**).* Yellow oil; ^1H NMR (300 MHz, $CDCl_3$): δ 7.79 (d, *J*=8.3 Hz, 2H), 7.30 (d, *J*=8.3 Hz, 2H), 4.52–4.33 (s, 2H), 3.49–3.41 (m, 1H), 2.99 (dd, *J*=13.6, 3.7 Hz, 1H), 2.72 (dd, *J*=13.6, 8.4 Hz, 1H), 2.42 (s, 3H), 1.42–1.08 (m, 12H), 0.85 (t, *J*=6.9 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.3 (C), 137.8 (C), 129.6 (2× CH), 127.1 (2× CH), 51.7 (CH), 46.0 (CH_2), 31.6 (CH_2), 29.6 (CH_2), 29.0 (CH_2), 25.3 (CH_2), 24.8 (CH_2), 22.5 (CH_2), 21.4 (CH), 14.0 (CH_3); MS (ESI^+) *m/z* (%) 313 ($[M+H]^+$, 100), 282 (2), 227 (1), 225 (8); HRMS (ESI^+) calcd for $[C_{16}H_{29}N_2O_2S]^+$ $[M+H]^+$ 313.1950, found 313.1944; IR (neat): 3434, 1638, 1450, 1325, 1160 cm^{-1}; R_f=0.26 (hexane/EtOAc 1:1).

*2.1.5.2. 4-Phenyl-N^2-tosylbutane-1,2-diamine (**6b**).* Yellow oil; ^1H NMR (300 MHz, $CDCl_3$): δ 7.71 (d, *J*=7.7 Hz, 2H), 7.29–7.13 (m, 5H), 7.06 (d, *J*=7.7 Hz, 2H); 6.46 (d, *J*=6.0 Hz, 1H), 4.35–4.29 (m, 1H), 4.00–3.62 (m, 1H), 2.77–2.46 (m, 3H), 2.39 (s, 3H), 2.03–1.73 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.3 (C), 140.8 (C), 137.2 (C), 129.5 (2× CH), 128.3 (2× CH), 127.1 (2× CH), 127.0 (2× CH), 125.9 (CH), 54.4 (CH), 46.09 (CH_2), 30.9 (CH_2), 25.0 (CH_2), 21.4 (CH_3); MS (ESI^+) *m/z* (%) 319 ($[M+H]^+$, 100), 288 (4), 164 (2) HRMS (ESI^+) calcd for $[C_{17}H_{23}N_2O_2S]^+$ $[M+H]^+$ 319.1480, found 319.1489; IR (neat): 3407, 1634, 1454, 1331, 1160 cm^{-1}; R_f=0.30 (hexane/EtOAc 1:1).

*2.1.5.3. 1-Cyclohexyl-N^1-tosylethane-1,2-diamine (**6c**).* Yellow oil; ^1H NMR (300 MHz, $CDCl_3$): δ 7.77 (d, *J*=8.0 Hz, 2H), 7.29 (d, *J*=8.0 Hz, 2H), 3.69 (t, *J*=5.4 Hz, 1H), 3.08 (s, 2H), 2.74 (dd, *J*=13.2, 6.0 Hz, 1H), 2.63 (dd, *J*=13.2, 4.3 Hz, 1H), 2.42 (s, 3H), 2.03–0.75 (m, 11H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.3 (C), 139.7 (C), 129.6 (2× CH), 127.0 (2× CH), 59.7 (CH_2), 41.8 (CH), 39.6 (CH), 29.6 (2× CH_2), 29.3 (CH_2), 29.0 (2× CH_2), 21.5 (CH_3); MS (ESI^+) *m/z* (%) 297 ($[M+H]^+$, 100), 266 (4); HRMS (ESI^+) calcd for $[C_{15}H_{25}N_2O_2S]^+$ $[M+H]^+$ 297.1637, found 297.1631; IR (neat): 3406, 1648, 1449, 1329, 1158 cm^{-1}; R_f=0.28 (hexane/EtOAc 1:1).

*2.1.6. Synthesis of 2-amino-1-bromo-1-nitroalkanes **7**.* NaI (0.12 mmol, 0.15 equiv) was added to a stirred solution of bromonitromethane **2** (0.8 mmol, 1 equiv) and the corresponding imine **1** (0.8 mmol, 1 equiv) in THF (10 mL). After stirring the reaction mixture at room temperature for 5 h it was quenched with aqueous HCl (10 mL, 0.1 M) before the organic material was extracted with diethyl ether. The combined extracts were washed with an aqueous saturated solution of $Na_2S_2O_3$ and then dried over Na_2SO_4 and the solvent was removed under reduced pressure affording products **7**. Purification by column chromatography (hexane:EtOAc 3:1) was only necessary when the imine used is aromatic **1n**–**p**.

*2.1.6.1. 1-Bromo-1-nitro-N-tosylnonan-2-amine (**7a**).* Yellow solid; mp 138–142 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.71 (d, *J*=8.2 Hz, 2H), 7.69 (d, *J*=8.1 Hz, 2H), 7.25 (d, *J*=8.2 Hz, 2H), 7.24 (d, *J*=8.1 Hz, 2H), 6.14 (d, *J*=4.3 Hz, 1H), 6.09 (d, *J*=3.1 Hz, 1H), 5.81 (d, *J*=4.0 Hz, 1H), 5.78 (d, *J*=3.5 Hz, 1H), 3.90–3.78 (m, 2H), 2.34 (s, 6H), 1.79–1.17 (m, 24H), 0.85–0.73 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.9 (C), 143.8 (C), 136.7 (C), 136.5 (C), 129.6 (2× CH), 129.5 (2× CH), 126.9 (2× CH), 126.8 (2× CH), 85.2 (CH), 84.0 (CH), 57.6 (CH), 56.4 (CH), 31.2 (2× CH_2), 30.8 (CH_2), 29.7 (CH_2), 28.5 (2× CH_2), 28.4 (2× CH_2), 25.0 (CH_2), 24.3 (CH_2), 22.2 (2× CH_2), 21.2 (2× CH_2), 13.7 (2× CH_2); MS (ESI^+) *m/z* (%) 423 ($[M+2+H]^+$, 33), 421 ($[M+H]^+$, 31), 282 (100), 128 (37); HRMS (ESI^+) calcd for $[C_{16}H_{26}BrN_2O_4S]^+$ $[M+H]^+$ 421.0797, found 421.0791; IR (neat): 3273, 1562, 1385, 1337, 1163, 815 cm^{-1}; R_f=0.50 (hexane/EtOAc 3:1).

*2.1.6.2. 1-Bromo-3-methyl-1-nitro-N-tosylpentan-2-amine (**7b**).* Yellow solid; mp 140–143 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.83–7.60 (m, 8H), 7.35–7.18 (m, 8H), 6.04 (d, *J*=2.6 Hz, 1H), 5.99 (d, *J*=3.4 Hz, 1H), 5.97 (d, *J*=4.6 Hz, 1H), 5.83 (d, *J*=7.1 Hz, 1H), 5.28–4.90 (m, 4H), 4.16–3.94 (m, 4H), 2.34 (s, 12H), 1.88–1.72 (m, 2H), 1.71–1.68 (m, 2H), 1.48–1.06 (m, 8H), 0.93–0.69 (m, 24H); ^{13}C

NMR (75 MHz, $CDCl_3$): δ 143.7 (2× C), 143.6 (2× C), 137.6 (2× C), 137.4 (2× C), 129.4 (8× CH), 126.8 (8× CH), 85.3 (CH), 84.5 (CH), 81.9 (CH), 81.4 (CH), 61.8 (CH), 61.5 (CH), 61.1 (CH), 60.3 (CH), 38.4 (CH), 37.2 (CH), 36.6 (CH), 35.9 (CH), 26.3 (CH_2), 25.9 (CH_2), 24.4 (CH_2), 23.5 (CH_2), 21.3 (4× CH_3), 15.2 (CH_3), 15.1 (CH_3), 14.3 (CH_3), 13.1 (CH_3), 11.2 (CH_3), 10.8 (CH_3), 10.7 (CH_3), 10.3 (CH_3); MS (ESI^+) *m*/*z* (%) 381 ($[M+2+H]^+$, 26), 379 ($[M+H]^+$, 25), 240 (100), 214 (26), 149 (11), 122 (10); HRMS (ESI^+) calcd for $[C_{13}H_{20}BrN_2O_4S]^+$ $[M+H]^+$ 379.0327, found 379.0322; IR (neat): 3278, 1570, 1334, 1266, 1161, 739 cm^{-1}; R_f=0.37 (hexane/EtOAc 3:1).

*2.1.6.3. 2-Bromo-1-cyclohexyl-2-nitro-N-tosylethanamine (**7c**).* Yellow solid; mp 137–140 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.69 (d, *J*=8.3 Hz, 2H), 7.61 (d, *J*=8.3 Hz, 2H), 7.26–7.20 (m, 4H), 6.04 (d, *J*=2.6 Hz, 1H), 5.94 (d, *J*=5.4 Hz, 1H), 4.95 (d, *J*=8.8 Hz, 1H), 4.78 (d, *J*=9.1 Hz, 1H), 4.11–4.04 (m, 1H), 3.97–3.89 (m, 1H), 2.37 (s, 6H), 1.86–1.37 (m, 10H), 1.19–0.78 (m, 12H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 143.8 (C), 143.6 (C), 137.7 (C), 137.3 (C), 129.5 (2× CH), 129.4 (2× CH), 126.9 (2× CH), 126.7 (2× CH), 85.1 (CH), 81.8 (CH), 62.3 (CH), 61.6 (CH), 41.2 (CH), 39.6 (CH), 29.6 (CH_2), 29.5 (CH_2), 28.8 (2× CH_2), 27.4 (2× CH_2), 25.6 (2× CH_2), 25.4 (2× CH_2), 21.4 (2× CH_3); MS (ESI^+) *m*/*z* (%) 407 ($[M+2+H]^+$, 17), 405 ($[M+H]^+$, 17), 267 (6), 266 (100), 112 (16); HRMS (ESI^+) calcd for $[C_{15}H_{22}BrN_2O_4S]^+$ $[M+H]^+$ 405.0484, found 405.0478; IR (neat): 3256, 1566, 1330, 1265, 1157, 738 cm^{-1}; R_f=0.40 (hexane/EtOAc 3:1).

*2.1.6.4. 1-Bromo-1-nitro-4-phenyl-N-tosylbutan-2-amine (**7d**).* Yellow solid; mp 135–138 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.73 (d, *J*=8.0 Hz, 2H), 7.67 (d, *J*=7.2 Hz, 2H), 7.33–7.04 (m, 10H), 6.91 (d, *J*=8.0 Hz, 2H), 6.85 (d, *J*=7.2 Hz, 2H), 6.09 (d, *J*=4.3 Hz, 1H), 6.02 (d, *J*=2.8 Hz, 1H), 5.37–5.18 (m, 2H), 3.96–3.85 (m, 2H), 2.60–2.46 (m, 2H), 2.39–2.26 (m, 2H), 2.37 (s, 6H), 2.11–2.00 (m, 1H), 1.94–1.65 (m, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 144.2 (C), 144.1 (C), 139.4 (C), 139.2 (C), 136.6 (C), 136.5 (C), 129.8 (2× CH), 129.5 (2× CH), 128.3 (4× CH), 128.1 (2× CH), 128.0 (2× CH), 127 (2× CH), 126.9 (2× CH), 126.2 (CH), 126.1 (CH), 84.8 (CH), 83.7 (CH), 57.3 (CH), 56.2 (CH), 32.5 (CH_2), 31.8 (CH), 31.3 (CH_2), 30.7 (CH_2), 21.4 (2× CH_3); MS (ESI^+) *m*/*z* (%) 429 ($[M+2+H]^+$, 100), 427 ($[M+H]^+$, 92), 359 (14), 134 (20), 288 (28), 134 (19), 117 (15); HRMS (ESI^+) calcd for $[C_{17}H_{20}BrN_2O_4S]^+$ $[M+H]^+$ 427.0327, found 427.0322; IR (neat): 3055, 1571, 1352, 1265, 1165, 747 cm^{-1}; R_f=0.29 (hexane/EtOAc 3:1).

*2.1.6.5. N-(2-Bromo-1-cyclohexyl-2-nitroethyl)-4-methoxybenzenamine (**7e**).* Brown oil; ^1H NMR (300 MHz, $CDCl_3$): δ 6.71 (d, *J*=9.0 Hz, 2H), 6.63 (d, *J*=9.0 Hz, 2H), 6.56 (d, *J*=9.0 Hz, 2H), 6.48 (d, *J*=9.0 Hz, 2H), 6.20 (d, *J*=3.2 Hz, 2H), 5.84 (d, *J*=8.0 Hz, 2H), 4.01–3.95 (m, 2H), 3.64 (s, 3H), 3.63 (s, 3H), 1.95–0.76 (m, 22H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 152.8 (C), 152.6 (C), 140.8 (C), 140.3 (C), 114.8 (4× CH), 114.6 (4× CH), 87.1 (CH), 81.3 (CH), 63.8 (CH), 63.0 (CH), 55.5 (2× CH_3), 43.0 (CH), 39.5 (CH), 31.2 (CH_2), 30.3 (CH_2), 29.9 (CH_2), 29.2 (CH_2), 28.7 (CH_2), 26.4 (CH_2), 25.8 (CH_2), 25.6 (CH_2), 25.3 (CH_2), 24.9 (CH_2); MS (ESI^+) *m*/*z* (%) 359 ($[M+2+H]^+$, 10), 357 ($[M+H]^+$, 27), 218 (100), 154 (12); HRMS (ESI^+) calcd for $[C_{15}H_{22}BrN_2O_3]^+$ $[M+H]^+$ 357.0814, found 357.0810; IR (neat): 3340, 1552, 1514, 1380, 1265, 738 cm^{-1}; R_f=0.30 (hexane/EtOAc 3:1).

*2.1.6.6. tert-Butyl 2-bromo-2-nitro-1-phenylethylcarbamate (**7f**).* White solid; mp 102–104 °C, ^1H NMR (300 MHz, $CDCl_3$): δ 7.56–6.09 (m, 10H), 6.24 (s, 2H), 5.71 (d, *J*=9.3 Hz, 1H), 5.64–5.53 (m, 1H), 5.40–5.31 (m, 2H), 1.47 (s, 9H), 1.46 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 154.6 (C), 154.4 (C), 135.2 (C), 134.7 (C), 129.1 (2× CH), 129.0 (4× CH), 126.9 (2× CH), 126.7 (2× CH), 85.1 (CH), 81.5 (CH), 81.1 (C), 80.9 (C), 58.1 (2× CH), 28.1 (6× CH_3); MS (ESI^+) *m*/*z* (%) 347 ($[M+2+H]^+$, 100), 345 ($[M+H]^+$, 87), 293 (41), 113 (14); HRMS (ESI^+) calcd for $[C_{13}H_{17}BrN_2O_4Na]^+$ $[M+Na]^+$ 367.0269, found 367.0277; IR (neat): 3375, 1682, 1563, 1366, 701 cm^{-1}; R_f=0.50 (Hexane/EtOAc 3:1).

*2.1.6.7. tert-Butyl 2-bromo-1-(4-cyanophenyl)-2-nitroethylcarbamate (**7g**).* White solid; mp 100–102 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.71 (d, *J*=8.4 Hz, 2H), 7.69 (d, *J*=8.4 Hz, 2H), 7.48 (d, *J*=8.4 Hz, 2H), 7.45 (d, *J*=8.4 Hz, 2H), 6.33 (d, *J*=7.1 Hz, 2H), 5.80 (d, *J*=9.2 Hz, 1H), 5.74–5.72 (m, 1H), 5.58–5.43 (m, 2H), 1.48 (s, 9H), 1.43 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 154.5 (C), 154.2 (C), 140.4 (C), 139.8 (C), 132.8 (4× CH), 127.9 (2× CH), 127.6 (2× CH), 117.9 (2× C), 113.3 (C), 113.1 (C), 84.2 (C), 81.6 (CH), 80.5 (2× CH), 57.7 (2× CH), 28.1 (6× CH_3); MS (ESI^+) *m*/*z* (%) 372 ($[M+2+H]^+$, 22), 370 ($[M+H]^+$, 100), 314 (54), 175 (9), 131 (15); HRMS (ESI^+) calcd for $[C_{14}H_{17}BrN_3O_4]^+$ $[M+H]^+$ 370.0402, found 370.0404; IR (neat): 3419, 2231, 1689, 1558, 1368, 736 cm^{-1}; R_f=0.38 (hexane/EtOAc 3:1).

*2.1.6.8. tert-Butyl 2-bromo-1-(4-methoxyphenyl)-2-nitroethylcarbamate (**7h**).* White solid; mp 99–101 °C; ^1H NMR (300 MHz, $CDCl_3$): δ 7.15 (apparent t, *J*=7.5 Hz, 4H), 6.80 (d, *J*=7.5 Hz, 4H), 6.33–6.11 (m, 2H), 5.82–5.65 (m, 1H), 5.57–5.17 (m, 2H), 3.70 (s, 6H), 1.36 (s, 18H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 160.0 (2× C), 154.6 (C), 154.4 (C), 128.2 (2× CH), 128.0 (2× CH), 127.0 (C), 126.6 (C), 114.3 (4× CH), 84.8 (CH), 81.9 (CH), 80.8 (2× C), 57.7 (CH), 57.6 (CH), 55.2 (2× CH_3), 28.01 (6× CH_3); MS (ESI^+) *m*/*z* (%) 400 ($[M+2+Na]^+$, 93), 398 ($[M+Na]^+$, 60), 319 (100), 258 (85), 180 (17); HRMS (ESI^+) calcd for $[C_{14}H_{19}BrN_2O_5]^+$ $[M+H]^+$ 375.0556, found 375.0550; IR (neat): 3375, 1682, 1562, 1367, 742 cm^{-1}; R_f=0.33 (hexane/EtOAc 3:1).

*2.1.7. Synthesis of N-(p-methoxyphenyl)imines **10**.* The *p*-methoxyphenylimines **10** were prepared in nearly quantitative yields by stirring for 2 h a solution in CH_2Cl_2 of the corresponding aldehyde (10 mmol, 1.0 equiv) with *p*-anisidine (10 mmol, 1.0 equiv) in the presence of molecular sieves, at room temperature, for 16 h under inert atmosphere. Imines **10** were obtained as brown oils, which were utilised without further purification.

*2.1.7.1. 3-O-Benzyl-5-deoxy-1,2-O-isopropylidene-5-[(4-methoxyphenyl)imino]-α-D-xylofuranose (**10a**).* Orange oil; $[\alpha]_D^{20}$ −30.9 (*c* 0.7, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$): δ 7.85 (d, *J*=5.2 Hz, 1H), 7.26–7.19 (m, 5H), 7.00 (d, *J*=8.9 Hz, 2H), 6.79 (d, *J*=8.9 Hz, 2H), 6.01 (d, *J*=3.6 Hz, 1H), 4.82 (apparent t, *J*=4.2 Hz, 1H), 4.60 (d, *J*=3.6 Hz, 1H), 4.49 (d, *J*=12,0 Hz, 1H), 4.41 (d, *J*=12,0 Hz, 1H); 4.17 (d, *J*=3.3 Hz, 1H), 3.70 (s, 3H), 1.42 (s, 3H), 1.25 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.9 (CH), 158.4 (C), 143.6 (C), 137.0 (C), 128.3 (2× CH), 127.8 (CH), 127.4 (2× CH), 122.0 (2× CH), 114.2 (2× CH), 112.0 (C), 105.6 (CH), 84.5 (CH), 82.6 (CH), 82.1 (CH), 72.2 (CH_2), 55.3 (CH_3), 26.7 (CH_3), 26.2 (CH_3); MS (ESI^+) *m*/*z* (%) 401 ($[M+NH_4]^+$, 45), 384 ($[M+H]^+$, 100), 339 (10), 326 (6); HRMS (ESI^+) calcd for $[C_{22}H_{26}NO_5]^+$ $[M+H]^+$ 384.1811, found 384.1805; IR (neat): 3055, 1695, 1513, 1266 cm^{-1}; R_f=0.50 (hexane/EtOAc 3:1).

*2.1.7.2. 3-O-Methyl-5-deoxy-1,2-O-isopropylidene-5[(4-methoxyphenyl)imino]-α-D-xylofuranose (**10b**).* Orange oil; $[\alpha]_D^{20}$ +5.7 (*c* 0.6, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$): δ 7.89 (d, *J*=5.9 Hz, 1H), 7.07 (d, *J*=8.8 Hz, 2H), 6.83 (d, *J*=8.8 Hz, 2H), 6.00 (d, *J*=3.6 Hz, 1H), 4.82 (dd, *J*=5.2, 3.5 Hz, 1H), 4.61 (d, *J*=3.7 Hz, 1H), 3.97 (d, *J*=3.5 Hz, 1H), 3.74 (s, 3H), 3.33 (s, 3H), 1.47 (s, 3H), 1.29 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.7 (CH), 158.4 (C), 143.6 (C), 122.0 (2× CH), 114.2 (2× CH), 112.0 (C), 105.5 (CH), 86.8 (CH), 82.0 (CH), 81.9 (CH), 58.1 (CH_3), 55.3 (CH_3), 26.7 (CH_3), 26.2 (CH_3); MS (ESI^+) *m*/*z* (%) 308 ($[M+H]^+$, 61), 248 (29), 136 (100), 124 (89), 105 (30); HRMS (ESI^+) calcd for $[C_{16}H_{22}NO_5]^+$ $[M+H]^+$ 308.1498, found 308.1492; IR (neat): 3054, 1652, 1506, 1247 cm^{-1}; R_f=0.50 (hexane/EtOAc 3:1).

*2.1.7.3. 1-O-tert-Butyldimethylsilyl-5-deoxy-2,3-O-isopropylidene-5[(4-methoxyphenyl)imino]-α-D-lyxofuranose (**10c**).* Orange oil; $[\alpha]_D^{20}$ +6.3 (*c* 0.6, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$): δ 7.85 (d, *J*=5.3 Hz, 1H), 7.12 (d, *J*=8.8 Hz, 2H), 6.86 (d, *J*=8.8 Hz, 2H), 5.45 (s, 1H), 4.99 (dd, *J*=5.5, 4.2 Hz, 1H), 4.72 (apparent t, *J*=4.6 Hz, 1H), 4.60 (d, *J*=5.7 Hz, 1H), 3.77 (s, 3H), 1.47 (s, 3H), 1.29 (s, 3H), 0.88 (s, 9H), 0.16 (s, 3H), 0.12 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 159.8 (CH), 158.3 (C), 143.9 (C), 122.1 (2× CH), 114.1 (2× CH), 112.6 (C), 101.8 (CH), 86.8 (CH), 82.1 (CH), 81.3 (CH), 55.2 (CH_3), 25.9 (CH_3), 25.5 (3× CH_3), 24.5 (CH_3), 17.7 (C), −4.6 (CH_3), −5.6 (CH_3); MS (ESI^+) *m*/*z* (%) 430 ($[M+Na]^+$, 47), 408 ($[M+H]^+$, 100), 301 (32), 109 (6); HRMS (ESI^+) calcd for $[C_{21}H_{34}NO_5Si]^+$ $[M+H]^+$ 408.2209, found 408.2206; IR (neat): 1652, 1510, 1242, 1082, 860, 840 cm^{-1}; R_f=0.47 (hexane/EtOAc 1:1).

*2.1.7.4. 6-Deoxy-1,2:3,4-di-O-isopropylidene-6[(4-methoxyphenyl)imino]-α-D-galactopyranose (**10d**).* Orange oil; $[\alpha]_D^{20}$ +7.2 (*c* 0.6, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$): δ 7.75 (d, *J*=4.0 Hz, 1H), 7.03 (d, *J*=8.6 Hz, 2H), 6.78 (d, *J*=8.6 Hz, 2H), 5.56 (d, *J*=4.9 Hz, 1H), 4.58 (dd, *J*=7.7, 2.3 Hz, 1H), 4.45–4.22 (m, 2H), 4.28 (dd, *J*=5.0, 2.4 Hz, 1H), 3.69 (s, 3H), 1.48 (s, 3H), 1.39 (s, 3H), 1.26 (s, 3H), 1.24 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): δ 160.9 (CH), 158.1 (C), 143.7 (C), 121.8 (2× CH), 113.9 (2× CH), 109.2 (C), 108.5 (C), 96.0 (CH), 73.1 (CH), 70.3 (CH), 70.2 (CH), 55.1 (CH_3), 53.2 (CH), 25.8 (CH_3), 25.7 (CH_3), 24.6 (CH_3), 24.0 (CH_3); MS (ESI^+) *m*/*z* (%) 364 ($[M+H]^+$, 100), 338 (7), 322 (30), 306 (4); HRMS (ESI^+) calcd for $[C_{19}H_{26}NO_6]^+$ $[M+H]^+$ 364.1760, found 364.1755; IR (neat): 3060, 1674, 1510, 1260 cm^{-1}; R_f=0.62 (hexane/EtOAc 3:1).

*2.1.8. Synthesis of 2-amino-1-nitroalkanes **11**.* SmI_2 or SmI_3 (0.8 mmol, 1 equiv) in THF (8 mL) was added to a stirred solution of bromonitromethane **2** (0.8 mmol, 1 equiv) and the corresponding imines **10** (0.8 mmol, 1 equiv) in THF (5 mL). After stirring the reaction mixture at room temperature for 5 h it was quenched with aqueous HCl (10 mL, 0.1 M) and then, the organic material was extracted with dichloromethane. The combined extracts were washed with an aqueous saturated solution of $Na_2S_2O_3$, then dried over Na_2SO_4 and the solvents were removed under reduced pressure affording compounds **11**, which were purified by column chromatography (hexane:EtOAc 3:1).

*2.1.8.1. 3-O-Benzyl-5,6-dideoxy-1,2-O-isopropylidene-5-p-methoxyphenylamino-6-nitro-α-D-glucofuranose (**11a**).* Yellow oil; $[\alpha]_D^{27}$ −9.2 (*c* 0.6, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$): δ 7.34–7.12 (m, 5H), 6.54 (d, *J*=9.0 Hz, 2H), 6.34 (d, *J*=9.0 Hz, 2H), 5.83 (d, *J*=3.6 Hz, 1H), 4.67 (dd, *J*=13.1, 3.9 Hz, 1H), 4.59–4.44 (m, 3H), 4.42–4.38 (m, 1H), 4.24–4.17 (m, 3H), 4.02 (d, *J*=3.1 Hz, 1H), 3.73 (s, 3H), 1.47 (s, 3H); 1.31 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 153.3 (C), 139.3 (C), 136.9 (C), 128.4 (2× CH), 128.0 (CH), 127.9 (2× CH), 116.3 (2× CH), 114.9 (2× CH), 112.1 (C), 104.9 (CH), 81.9 (CH), 81.2 (CH), 79.9 (CH), 75.8 (CH_2), 72.1 (CH_2), 55.6 (CH_3), 51.9 (CH), 26.7 (CH_3), 26.2 (CH_3); MS (ESI^+) *m*/*z* (%) 445 ($[M+H]^+$, 100), 444 (1), 316 (5), 289 (1), 288 (21); HRMS (ESI^+) calcd for $[C_{23}H_{29}N_2O_7]^+$ $[M+H]^+$ 445.1975, found 445.1969; IR (neat): 3380, 1556, 1513, 1377, 1241 cm^{-1}; R_f=0.28 (hexane/AcOEt 3:1).

*2.1.8.2. 3-O-Methyl-5,6-dideoxy-1,2-O-isopropylidene-5-p-methoxyphenylamino-6-nitro-α-D-glucofuranose (**11b**).* Orange oil; ^1H NMR (300 MHz, $CDCl_3$): major isomer δ 6.79–6.73 (m, 4H), 5.86 (d, *J*=3.6 Hz, 1H), 4.74 (dd, *J*=13.2, 4.0 Hz, 1H), 4.60–4.51 (m, 3H), 4.44–4.36 (m, 1H), 4.19 (dd, *J*=8.1, 3.0 Hz, 1H), 3.85 (d, *J*=4.0 Hz, 1H), 3.74 (s, 3H), 3.19 (s, 3H), 1.48 (s, 3H), 1.33 (s, 3H); minor isomer 6.70–6.67 (m, 4H), 5.91 (d, *J*=3.8 Hz, 1H), 4.68–4.63 (m, 1H), 4.49–4.45 (m, 3H), 4.44–4.36 (m, 1H), 4.14–4.07 (m, 1H), 3.75 (s, 3H), 3.72 (d, *J*=2.9 Hz, 1H), 3.39 (s, 3H), 1.52 (s, 3H), 1.35 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): major isomer δ 153.2 (C), 139.5 (C), 116.3 (2× CH), 114.7 (2× CH), 111.9 (C), 104.8 (CH), 83.1 (CH), 81.2 (CH), 80.0 (CH), 76.2 (CH_2), 57.4 (CH_3), 55.5 (CH_3), 52.1 (CH), 26.7 (CH_3), 26.1 (CH_3); minor isomer δ 153.1 (C), 139.6 (C), 115.6 (2× CH), 114.9 (2× CH), 111.8 (C), 104.7 (CH), 84.3 (CH), 80.6 (CH), 79.2 (CH), 76.1 (CH_2), 57.1 (CH_3), 55.5 (CH_3), 53.1 (CH), 26.7 (CH_3), 26.1 (CH_3); MS (ESI^+) *m*/*z* (%) 391 ($[M+Na]^+$, 4), 369 ($[M+H]^+$, 100), 330 (6), 311 (8), 308 (5); HRMS (ESI^+) calcd for $[C_{17}H_{25}N_2O_7]^+$ $[M+H]^+$ 369.1662, found 369.1656; IR (neat): 3371, 1515, 1384, 1246 cm^{-1}; R_f=0.50 (hexane/AcOEt 3:1).

*2.1.8.3. 1-O-tert-Butyldimethylsilyl-5,6-deoxy-2,3-di-O-isopropylidene-5-p-methoxyphenylamino-6-nitro-α-D-mannofuranose (**11c**).* Orange oil; ^1H NMR (500 MHz, $CDCl_3$): major isomer δ 6.80–6.77 (m, 4H), 5.29 (apparent s, 1H), 4.83 (dd, *J*=3.5, 2.2 Hz, 1H); 4.72 (dd, *J*=8.0, 2.5 Hz, 1H), 4.57–4.52 (m, 1H), 4.53 (dd, *J*=5.1, 3.5 Hz, 1H), 4.40–4.36 (m, 1H), 4.18 (dd, *J*=4.5, 2.1 Hz, 1H), 3.75 (s, 3H), 1.51 (s, 3H), 1.31 (s, 3H), 0.86 (s, 9H), 0.11 (s, 3H), 0.07 (s, 3H); minor isomer δ 6.73–6.68 (m, 4H), 5.33 (apparent s, 1H), 4.82–4.78 (m, 1H); 4.69 (dd, *J*=7.6, 4.0 Hz, 1H), 4.60 (dd, *J*=8.0, 3.2 Hz, 1H), 4.58–4.52 (m, 1H), 4.40–4.36 (m, 1H), 4.33 (dd, *J*=3.9, 2.2 Hz, 1H), 3.75 (s, 3H), 1.48 (s, 3H), 1.31 (s, 3H), 0.87 (s, 9H), 0.10 (s, 3H), 0.07 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): major isomer δ 153.1 (C), 139.3 (C), 116.5 (2× CH), 115.2 (CH), 114.6 (2× CH), 112.2 (C), 101.0 (CH), 86.6 (CH), 79.4 (CH), 75.2 (CH_2), 55.2 (CH_3), 52.5 (CH), 25.7 (CH_3), 25.3 (3× CH_3), 24.3 (CH_3), 17.5 (C), −4.8 (CH_3), −5.8 (CH_3); minor isomer; δ 152.8 (C), 139.7 (C), 116.5 (2× CH), 115.2 (CH), 114.6 (2× CH), 112.4 (C), 101.0 (CH), 79.0 (CH), 78.0 (CH), 76.1 (CH_2), 55.2 (CH_3), 53.0 (CH), 25.5 (CH_3), 25.3 (3× CH_3), 23.9 (CH_3), 17.5 (C), −4.7 (CH_3), −5.7 (CH_3); MS (ESI^+) *m*/*z* (%) 491 ($[M+Na]^+$, 2), 469 ($[M+H]^+$, 100), 408 (13), 337 (9); HRMS (ESI^+) calcd for $[C_{22}H_{37}N_2O_7Si]^+$ $[M+H]^+$ 469.2370, found 469.2365; IR (neat): 3385, 1555, 1515, 1377, 1242 cm^{-1}; R_f=0.53 (hexane/AcOEt 3:1).

*2.1.8.4. 6,7-Dideoxy-1,2:3,4-di-O-isopropylidene-6-p-methoxyphenylamino-7-nitro-D-glycero-β-D-galacto-heptose (**11d**).* Orange oil; ^1H NMR (300 MHz, $CDCl_3$): major isomer δ 6.79–6.75 (m, 2H), 6.73–6.66 (m, 2H), 5.53 (d, *J*=3.0 Hz, 1H), 4.87 (dd, *J*=8.1, 2.3 Hz, 1H), 4.61–4.59 (m, 1H), 4.59–4.57 (m, 1H), 4.37 (dd, *J*=4.9, 1.1 Hz, 1H); 4.29 (dd, *J*=3.3, 1.8 Hz, 1H), 4.27 (dd, *J*=2.8, 2.0 Hz, 1H), 3.95 (dd, *J*=3.6, 1.0 Hz, 1H), 3.73 (s, 3H), 1.47 (s, 3H), 1.33 (s, 3H), 1.31 (s, 3H), 1.29 (s, 3H); minor isomer δ 6.79–6.78 (m, 2H), 6.72–6.65 (m, 2H), 5.56 (d, *J*=3.0 Hz, 1H), 4.81 (dd, *J*=8.1, 3.1 Hz, 1H), 4.67 (dd, *J*=7.8, 4.3 Hz, 1H), 4.59–4.57 (m, 1H), 4.43–4.40 (m, 1H), 4.35 (dd, *J*=4.7, 1.0 Hz, 1H), 4.32 (dd, *J*=3.0, 1.4 Hz, 1H), 4.12 (dd, *J*=2.9, 1.7 Hz, 1H), 3.74 (s, 3H), 1.46 (s, 3H), 1.33 (s, 3H), 1.32 (s, 3H), 1.29 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): major isomer δ 153.5 (C), 139.8 (C), 117.0 (2× CH), 114.9 (2× CH), 109.4 (C), 108.8 (C), 96.3 (CH), 75.1 (CH_2), 71.1 (CH), 70.9 (CH), 70.7 (CH), 67.0 (CH), 55.6 (CH_3), 54.6 (CH), 25.8 (CH_3), 25.7 (CH_3), 24.8 (CH_3), 24.0 (CH_3); minor isomer; δ 153.0 (C), 139.9 (C), 115.1 (2× CH), 115.0 (2× CH), 109.6 (C), 108.9 (C), 96.5 (CH), 76.0 (CH_2), 70.9 (2× CH), 70.4 (CH), 65.4 (CH), 55.6 (CH_3), 54.8 (CH), 25.8 (2× CH_3), 24.8 (CH_3), 24.0 (CH_3); MS (ESI^+) *m*/*z* (%) 447 ($[M+Na]^+$, 5), 424 ($[M+H]^+$, 100), 386 (22), 364 (26); HRMS (ESI^+) calcd for $[C_{20}H_{29}N_2O_8]^+$ $[M+H]^+$ 425.1924, found 425.1918; IR (neat): 3366, 1552, 1511, 1381, 1237 cm^{-1}; R_f=0.46 (hexane/AcOEt 3:1).

*2.1.9. Synthesis of 2-amino-1-bromo-1-nitroalkanes **12**.* NaI (0.12 mmol, 0.15 equiv) was added to a stirred solution of bromonitromethane **2** (0.8 mmol, 1 equiv) and the corresponding imines **10** (0.8 mmol, 1 equiv) in THF (10 mL). After stirring the reaction mixture at room temperature for 5 h it was quenched with aqueous HCl (10 mL, 0.1 M) before the organic material was extracted with diethyl ether. The combined extracts were washed with an aqueous saturated solution of $Na_2S_2O_3$ and then dried over Na_2SO_4 and the solvent was removed under reduced pressure. Purification by column chromatography (hexane/EtOAc 3:1) afforded compounds **12** as a mixture of stereoisomers.

2.1.9.1. (6R)-3-O-Benzyl-6-bromo-5,6-dideoxy-1,2-O-isopropylidene-5-p-methoxyphenylamino-6-nitro-α-D-glucofuranose

(***12a***). White solid; mp 100–101 °C; $[\alpha]_D^{27}$ –41.1 (*c* 0.9, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$): δ 7.29–7.27 (m, 3H), 7.14–7.11 (m, 2H), 6.59 (s, 4H), 6.49 (d, *J*=2.2 Hz, 1H), 5.90 (d, *J*=3.5 Hz, 1H), 4.91–4.88 (m, 1H), 4.54 (d, *J*=3.5 Hz, 1H), 4.34 (d, *J*=11.5 Hz, 1H), 4.14–4.04 (m, 2H), 4.02 (d, *J*=11.5 Hz, 1H), 3.94 (d, *J*=3.0 Hz, 1H), 3.66 (s, 3H), 1.49 (s, 3H), 1.30 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 153.4 (C), 138.7 (C), 136.9 (C), 128.7 (CH), 128.3 (2× CH), 127.9 (2× CH), 116.2 (2× CH), 114.7 (2× CH), 112.5 (C), 105.3 (CH), 88.0 (CH), 81.6 (CH), 81.3 (CH), 80.7 (CH), 72.5 (CH_2), 56.9 (CH), 55.6 (CH_3), 27.0 (CH_3), 26.3 (CH_3); MS (ESI^+) *m*/*z* (%) 525 ($[M+2+H]^+$, 91), 523 ($[M+H]^+$, 100), 441 (39), 406 (72), 384 (26); HRMS (ESI^+) calcd for $[C_{23}H_{28}BrN_2O_7]^+$ $[M+H]^+$ 523.1080, found 523.1074; IR (neat): 3397, 1558, 1513, 1383, 1242, 736 cm^{-1}; R_f=0.32 (hexane/EtOAc 3:1).

*2.1.9.2. 6-Bromo-1-O-tert-butyldimethylsilyl-5,6-deoxy-2,3-di-O-isopropylidene-5-p-methoxyphenylamino-6-nitro-α-D-mannofuranose (**12b**).* Brown oil; ^1H NMR (300 MHz, $CDCl_3$): δ major isomer 6.84–6.69 (m, 4H), 6.47 (d, *J*=1.8 Hz, 1H), 5.97 (d, *J*=5.4 Hz, 1H), 5.33 (s, 1H), 4.83 (dd, *J*=3.2, 2.5 Hz, 2H), 4.54 (dd, *J*=6.3, 3.5 Hz, 1H), 4.19 (dd, *J*=5.0, 2.4 Hz, 1H), 3.72 (s, 3H), 1.58 (s, 3H), 1.30 (s, 3H), 0.89 (s, 9H), 0.12 (s, 3H), 0.11 (s, 3H); minor isomer 6.84–6.69 (m, 4H), 6.22 (d, *J*=2.2 Hz, 1H), 6.07 (d, *J*=4.0 Hz, 1H), 5.25 (s, 1H), 4.90 (dd, *J*=5.6, 1.1 Hz, 1H), 4.86 (dd, *J*=3.4, 2.2 Hz, 1H), 4.60 (apparent t, *J*=3.7 Hz, 1H), 3.94 (dd, *J*=5.7, 2.2 Hz, 1H), 3.76 (s, 3H), 1.54 (s, 3H), 1.31 (s, 3H), 0.87 (s, 9H), 0.10 (s, 3H), 0.09 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$): major isomer δ 153.5 (C), 138.8 (C), 116.6 (2× CH), 114.5 (2× CH), 112.7 (C), 101.4 (CH), 87.8 (CH), 86.6 (CH), 79.9 (CH), 79.2 (CH), 57.7 (CH), 55.5 (CH_3), 26.1 (CH_3), 25.5 (3× CH_3), 24.7 (CH_3), 17.8 (C), −4.3 (CH_3), −5.8 (CH_3); minor isomer δ 153.6 (C), 139.1 (C), 116.5 (2× CH), 114.9 (2× CH), 112.8 (C), 100.9 (CH), 87.0 (CH), 86.5 (CH), 80.2 (CH), 79.0 (CH), 57.7 (CH), 55.5 (CH_3), 26.1 (CH_3), 25.5 (3× CH_3), 24.7 (CH_3), 17.8 (C), −4.6 (CH_3), −5.5 (CH_3); MS (ESI^+) *m*/*z* (%) 549 ($[M+2+H]^+$, 100), 547 ($[M+H]^+$, 85), 441 (42), 430 (26), 108 (14); HRMS (ESI^+) calcd for $[C_{22}H_{36}BrN_2O_7Si]^+$ $[M+H]^+$ 547.1475, found 547.1470; IR (neat): 3400, 1560, 1515, 1378, 1246, 741 cm^{-1}; R_f=0.32 (hexane/EtOAc 3:1).

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23. CCDC 833254 contains the supplementary crystallographic data for compound **12a**. This data can be obtained free of charge via: www.ccdc.cam.ac.uk/conts/retrieving.html (or the Cambridge Data Center, 12 Union Road, Cambridge CB2 1EZ, UK; fax (+44)1223-336-033; or deposit@ccdc.cam.ac.uk).
24. A similar model has been used to explain the stereoselectivity observed in the addition of the nitronate and bromonitronate anions to L-alaninal (see Refs. 14 and 15, respectively).