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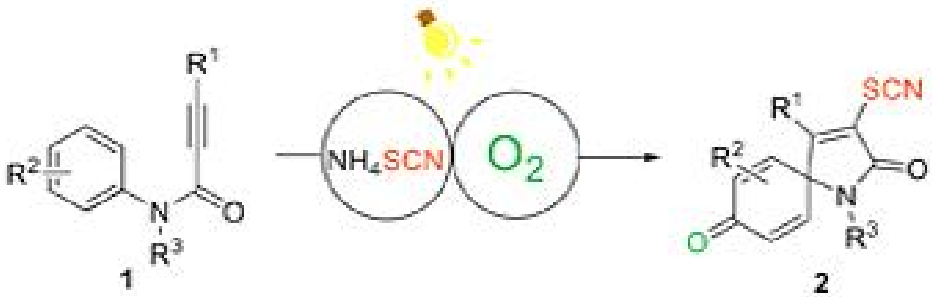
Visible-light-mediated selective thiocyanation/*ipso*-cyclization/oxidation cascade for the synthesis of thiocyanato-containing azaspirotrienediones



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Graphical Abstract

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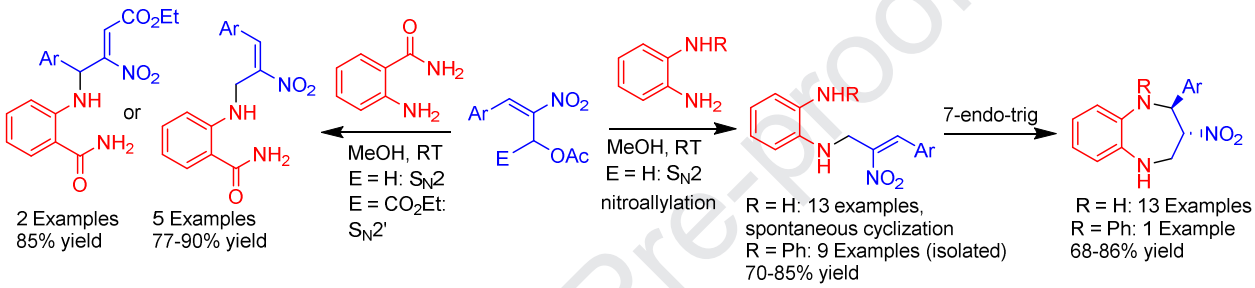

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Base and Catalyst-Free Synthesis of Nitrobenzodiazepines *via* a Cascade N-Nitroallylation-Intramolecular Aza-Michael Addition involving o-Phenylenediamines and Nitroallylic Acetates

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ABSTRACT

A [4+3] annulation of o-phenylenediamines with primary nitroallylic acetates affords nitrobenzodiazepines (NBDZs) in good to excellent yield. The reaction which proceeds in MeOH at room temperature in the absence of any base or catalyst involves a cascade S_N2 N-nitroallylation-intramolecular aza-Michael addition sequence. In the case of mono-N-arylated o-phenylenediamines and o-aminobenzamides, the reaction stops at the S_N2 stage affording nitroallylic amines. On the other hand, reaction of o-aminobenzamides with secondary nitroallylic acetates delivers S_N2' products. Formation of stable S_N2 and S_N2' products provides insights into the reactivity of primary and secondary nitroallylic acetates and also the mechanism of formation of nitrobenzodiazepines.

1. Introduction

Various natural products, drugs and active pharmaceutical ingredients possess heterocyclic rings which are primarily responsible for their biological activity.[1] Benzodiazepines which contain two nitrogens in an arene-fused seven membered ring are one of the highly privileged heterocyclic systems.[2] These compounds exhibit diverse biological activities and are among the most commonly prescribed anti-depressants (Figure 1).[3] Ever since the first benzodiazepine drug chlordiazepoxide has been reported in 1955 by Sternbach,[4] this class of compounds began receiving increasing attention. This resulted in the development of numerous drugs containing benzodiazepines.[5] The biological significance of benzodiazepine skeleton also prompted development of different synthetic routes from various precursors. These include reaction of *o*-phenylenediamine with different bielectrophiles,[6] one pot conversion of nitroarenes using bimetallic nanoparticles,[7] Au(I)-NHC-catalyzed synthesis from *N*-substituted *o*-phenylenediamines and terminal alkynes[8] etc.[9] Owing to the importance of nitro group in biologically active compounds,[10] and particularly nitrobenzodiazepines (NBDZs) as hypnotic and sedative drugs,[11] synthesis of novel NBDZs, in which the nitro group is attached to the 7-membered dinitrogen heterocycle rather than to the aromatic ring, via one pot cascade reactions from readily available starting materials appeared an attractive objective.

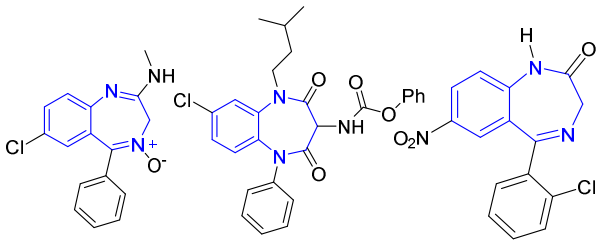


Figure 1. Bioactive molecules containing benzazepine skeleton

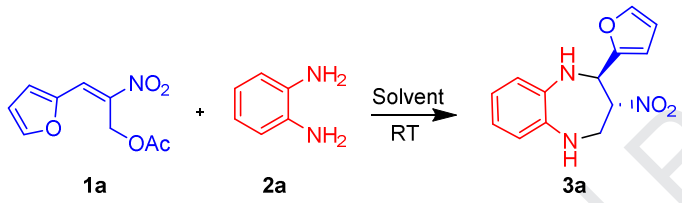
While one of the substrates for the synthesis of the NBDZs appeared to be 1,4-binucleophilic *o*-phenylenediamine, a 1,3-bielectrophilic nitroalkene derivative emerged as the other substrate. Over the years, we, Chen and others have been actively working on the synthetic applications of nitroallylic acetates, derived from Morita-Baylis-Hillman (MBH) reactions of nitroalkenes with activated carbonyl compounds.[12] Numerous fused and functionalized heterocycles including furans,[13] pyrans,[14] pyrroles,[15] dihydropyridopyrimidines,[16] imidazoles,[17] imidazopyridines,[18] benzimidazothiazines,[19] picolinate,[20] piperidines,[21] benzoxacinones,[22] thiopyranoindoles[23] etc have been synthesized from such nitroalkene derived MBH acetates by

us and other research groups. However, to the best of our knowledge, there is no report on the synthesis of benzodiazepines from MBH acetates as bielectrophiles through a [4+3] annulation strategy. Herein, we report the first direct synthesis of NBDZs from *o*-phenylenediamines and nitroallylic acetates through a cascade *N*-alkylation-intramolecular aza-Michael addition. Also included in this report are the results of our studies on the reactivity of related 1,4- and 1,5-binucleophiles towards MBH acetates.

2. Results and Discussion

Optimization studies by taking the bielectrophilic MBH acetate **1a** and the binucleophilic o-phenylediamine **2a** as the model substrates revealed that the reaction works smoothly in MeOH at room temperature as in the case of our imidazopyridine synthesis from aminopyridine and MBH acetate.[18] There was no requirement of any base or catalyst and the desired compound **3a** was formed in 78% yield as a single diastereomer in a short reaction time of 4 h (Table 1). The *trans* stereochemistry between the furyl group and the nitro group in **3a** was evident from a *J* value of 9.4 Hz for the coupling between the two aliphatic vicinal methine protons.

Table 1. Optimization of reaction conditions

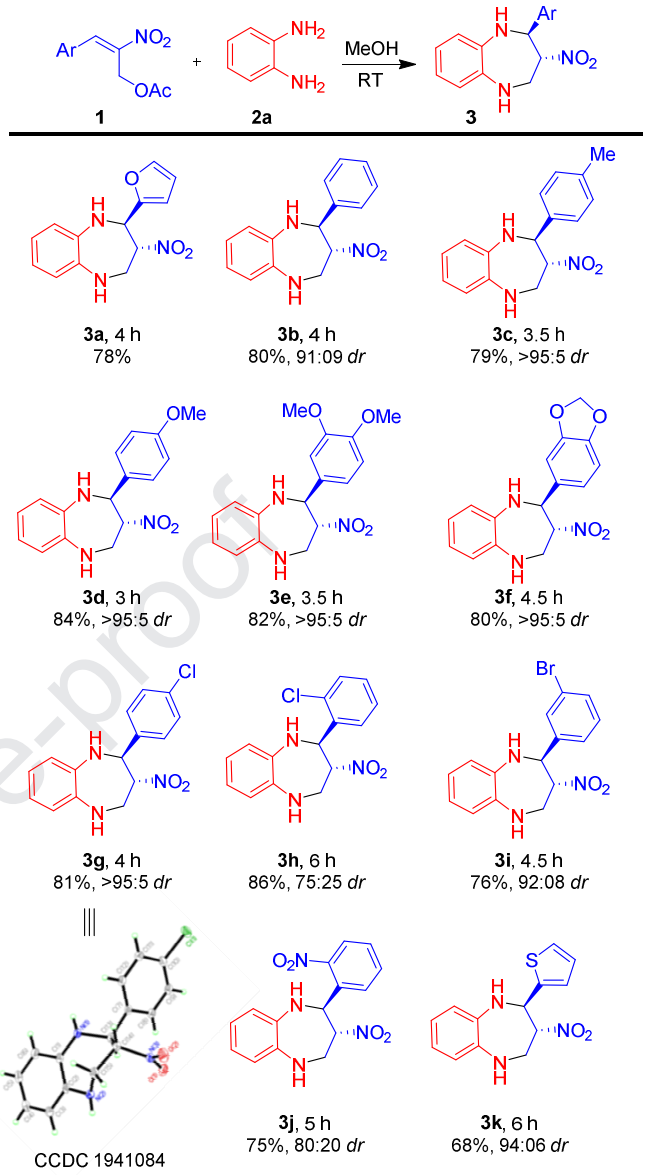


entry	Solvent	time (h)	yield (%)[a]
1	**MeOH**	**4**	**78**
2	EtOH	7	71
3	MeOH : H_2O[b]	5	26
4	MeCN	9	13
5	THF	8	23
6	DMF	12	traces
7	DCM	6	16

[a]After silica gel column chromatography. [b] 1:1 Ratio

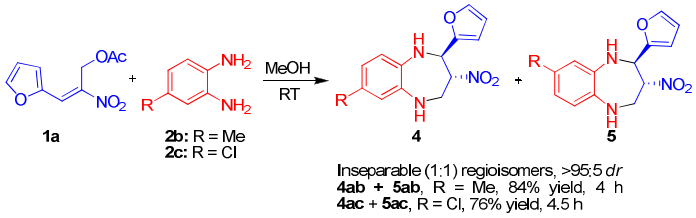
The scope of the reaction was then investigated with a diverse array of MBH acetates (Table 2). There was no appreciable substituent effect on the yield which remained in the range of 68-86%. For instance, MBH acetates **1a** and **1k** bearing heteroaryl groups afforded the diazepines **3a** and **3k** in 78% and 68% yields, respectively. Substrates bearing electroneutral aryl and weakly activated aryl **1b** and **1c**, respectively, provided the corresponding diazepines **3b** and **3c** in comparable yields (79-80%). Strongly activated aryls with single and multiple electron donating groups **1d-f** also helped maintain high yields (80-84%) of the products **3d-f**. While weakly and strongly electron withdrawing groups on the aryl ring of the substrates **1g-i** and **1j**, respectively, did not influence the yields of the diazepines **3g-j** to any appreciable extent (75-86%), ortho-substitution did affect the diastereoselectivity as in the case of **3h** and **3j**.

Table 2. Synthesis of benzodiazepines from o-phenylene-diamines and MBH acetates[a]



[a]Yield after silica gel column chromatography, dr was determined by ^{1}H NMR of the crude reaction mixture.

Subsequently, the reaction of substituted *o*-phenylenediamines **2b-c** with a representative MBH acetate **1a** led to the formation of an inseparable mixture of regioisomers **4ab**+**5ab** and **4ac**+**5ac**, respectively, in ~ 1:1 ratio (Scheme 1). However, the products were isolated as single diastereomers in high yields (76-84%).

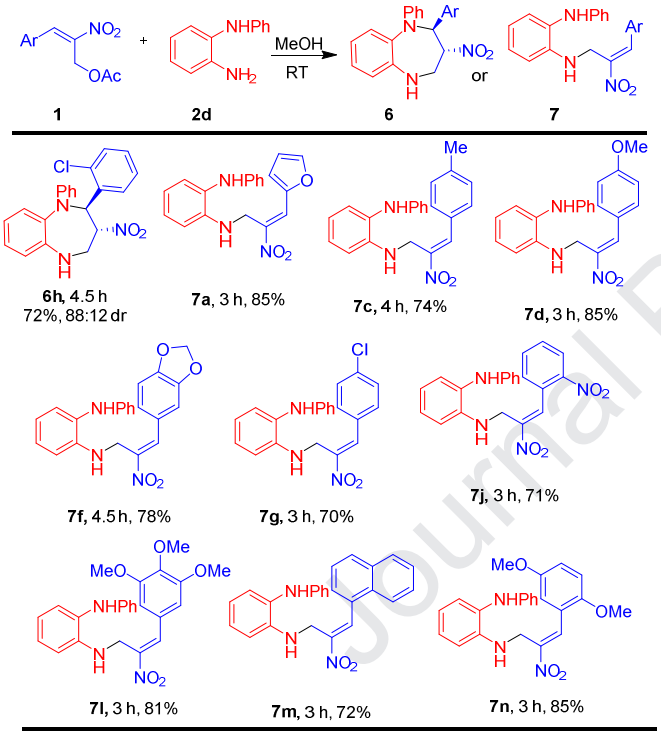


Scheme 1. Benzodiazepines from substituted *o*-phenylenediamines and MBH acetate

The effect of substituent on the amine nitrogen was then evaluated using **2d** as the representative binucleophile (Table 3). This enabled us to compare the reactivity of primary and secondary aromatic amines towards MBH acetate **1**. Though not

unexpected, we isolated only the S_N2 products **7** in most cases instead of diazepines **6**. The intramolecular cyclization has taken place only in the case of MBH acetate **1h** with an *ortho*-substituent on the aromatic ring which afforded diazepine **6h** in good yield (72%) and diastereoselectivity (88:12). However, this shed more light into the mechanism (vide infra) that the first step in the reaction would be S_N2 rather than S_N2'. The nitroallylic amines bearing weakly and strongly electron donating aryl groups **7a**, **7c**, **7d**, **7f**, **7l** and **7n** were formed in higher yields (74-85%) as compared to those bearing weakly and strongly electron withdrawing aryl groups **7g** and **7j** as well as the one with a fused aryl group **7m** (70-72%). The intramolecular cyclization of the above S_N2 products, including **7n** bearing an o-substituent, to diazepines **6** has not taken place upon heating[24] (conventional and microwave) and/or in the presence of a variety of bases such as DABCO, DBU, TMG, NaH, Cs_2CO_3, KOH and LiO^{t}Bu. Unfortunately, strong bases and/or extreme conditions caused decomposition of the substrates.

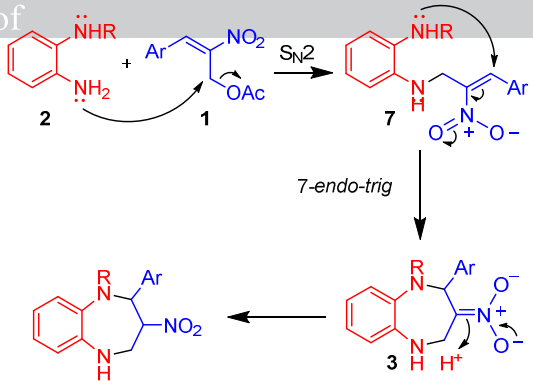
Table 3. Nitroallylation of N-phenyl-*o*-phenylenediamine with MBH acetates[a]



[a]Yield after silica gel column chromatography.

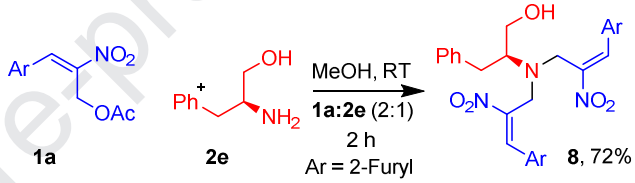
As briefly stated earlier, the relative stereochemistry of compounds **3-6** appeared to be *trans* from the *J* value of 9-10 Hz for the two aliphatic vicinal methine protons. However, a dihedral angle of 68.7° for the ArC-C-C-N chain in the X-ray structure of a representative compound **3g** suggested that the aryl and nitro groups have a synclinal relationship (See the SI).

In view of the isolation of S_N2 products **7**, the first step in the formation of NBDZs **3** is confirmed to be the S_N2 reaction of *o*-phenylenediamine **2** with MBH acetate **1** (Scheme 2). The reaction proceeds further in the case of *N*-unsubstituted *o*-phenylenediamines **2a-c** in an intramolecular aza-Michael fashion to afford NBDZs **3**. However, when the nucleophilicity of one of the amino groups is curtailed, as in the case of **2d**, the reaction stops at the S_N2 stage. Yet another reason for the reluctance of most of the S_N2 products **7** to undergo the intramolecular aza-Michael addition is a probable 1,2-allylic strain ($A^{1,2}$) between the two aryl groups in the transition state.



Scheme 2. Proposed mechanism for the formation of nitro-benzodiazepines

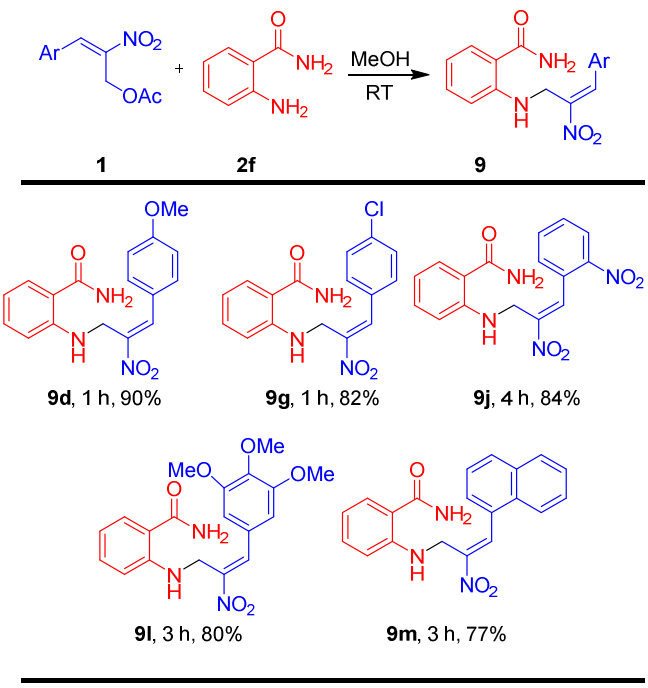
Under the above conditions, a 1,2-amino alcohol such as phenyl alaninol **2e** participated in the S_N2 reaction with MBH acetate **1a** (**1a:2e** in 2:1 ratio) displacing the acetate group twice to generate compound **8** (Scheme 3). This double nitroallylation of the amino group in **2e** provides novel bis-nitroallylic tertiary amines confirming the greater reactivity of aliphatic amines.



Scheme 3. Double nitroallylation of phenylalaninol with MBH acetate

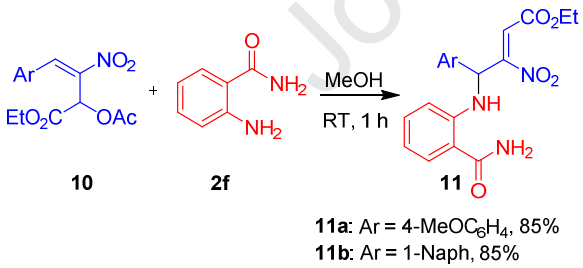
Having obtained NBDZs and their precursors depending upon the nature of the binucleophile, we intended to investigate the bielectrophilic nature of MBH acetate **1** with a binucleophile bearing strongly nucleophilic amino group and a weakly nucleophilic amido group. With this objective, we have chosen 2-aminobenzamide **2f** whose ability to react as a 1,5-binucleophile with electrophiles through both amine-N and amide-N in the formation of 6-membered rings (quinoxalines) is documented in the literature.[25] However, our experimentation with MBH acetates possessing electronically different aryl groups confirmed that the reaction stops at the S_N2 stage affording products **9** under these conditions (Table 4). This is attributable to the poor nucleophilicity of the amide group as well as entropically disfavored formation of an 8-membered ring. No appreciable substituent effect was observed on the yield of N-nitroallylation (S_N2) product as those with electron rich aryl groups **9d** and **9l** and those with electron poor aryl groups **9g** and **9j** were formed in excellent yield (80-90%). The naphthyl derivative **9m** was also formed in high yield (77%). Attempted cyclization of compounds **9** to 8-membered ring by heating and/or using different bases did not provide the desired results. But nevertheless, the multi-functional S_N2 products were formed in excellent yield (77-90%).

Table 4. Nitroallylation of 2-aminobenzamide with MBH acetates[a]



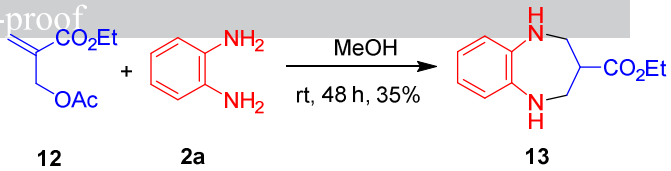
[a]Yield after silica gel column chromatography.

At this juncture, we wished to examine the reactivity of MBH acetate **10**, which was derived from nitroalkene and ethylglyoxylate, towards 2-aminobenzamide **2f** (Scheme 4). As expected, based on the reported reactivity of secondary acetate **10**,[12] it reacted in an S_N2' fashion, unlike the primary acetate **1** and provided product **11**. Two possible modes of intramolecular cyclization of compound **11**, viz 7-*exo-trig* and 8-*endo-trig* did not take place under a variety of thermal, including microwave, and/or base assisted conditions. Attempted reaction of MBH acetate **10** with o-phenylenediamine **2a** under these conditions and at 0°C as well as in other solvents such as EtOH, THF and DCM resulted in complex mixtures.[26]



Scheme 4. Reaction of 2-aminobenzamide with secondary MBH acetate

In order to examine the applicability of the above experimental conditions to other MBH acetates, ethyl acrylate derived MBH acetate **12** was treated with *o*-phenylenediamine **2a** (Scheme 5). The reaction afforded the expected diazepine **13**, though only in 35% yield and in long reaction time of 48 h.[27] This confirmed that our base and catalyst free method is applicable for the synthesis of benzo-1,4-diazepines, not only from MBH acetates derived from nitroalkenes but other activated alkenes as well.



Scheme 5. Reaction of ethyl acrylate derived MBH acetate with o-phenylenediamine

3. Conclusion

In conclusion, we have successfully demonstrated a simple and efficient way to synthesize nitrobenzodiazepines from MBH acetates of nitroalkenes and *o*-phenylenediamine without using any base or catalyst. The products are formed in good to excellent yields and excellent diastereoselectivity. The mechanism involves S_N2 N-nitroallylation followed by an intramolecular aza-Michael addition which was confirmed by isolation and characterization of several N-nitroallylated intermediates in the case of diamines/aminoamides with different nucleophilicities. The N-nitroallylated compounds in turn are multi-functional species bearing a conjugated nitroalkene, allylic amine and a secondary amine or a primary carboxamide moiety.

General Experimental Details.

The melting points recorded are uncorrected. NMR spectra (^{1}H, ^{1}H decoupled ^{13}C and ^{1}H-^{1}H COSY) were recorded with TMS as the internal standard. The coupling constants (*J* values) are given in Hz. High resolution mass spectra were recorded under ESI Q-TOF conditions. X-ray data were collected on a diffractometer equipped with graphite monochromated Mo Kα radiation. The structure was solved by direct methods shelxs97 and refined by full-matrix least squares against F^2 using shelxl97 software. Amines and aminoamides **2a-f** were commercially available. MBH acetates **1**,[28] **10**[29] and **12**[30] were prepared by literature methods. The identity and purity of substrates **1**, **10** and **12** were in general confirmed by comparison of their physical and spectroscopic data with those reported in the literature.[28-30]

General procedure for the reaction of MBH acetate 1 with amines 2a-e.

To a stirred solution of MBH acetate **1** (0.5 mmol) in methanol (5 mL) at room temperature was added amino compound **2** (0.5 mmol). The reaction mixture was stirred till complete consumption of the starting materials (monitored by TLC). The solvent was evaporated in *vacuo* and the crude residue was purified by silica gel column chromatography (10-20% EA / pet ether).

2-(Furan-2-yl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo-[b][1,4]diazepine (3a). Yellow solid; Yield 101 mg, 78%, dr >95:05; mp 90 °C; IR (film, cm^{-1}) 3394 (br m), 2925 (w), 1601 (m), 1554 (s), 1506 (m), 1457 (m), 1266 (m), 1014 (m), 745 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.43 (dd, *J* = 1.7, 0.6 Hz, 1H), 6.71-6.79 (m, 2H), 6.63 (td, *J* = 7.5, 1.7 Hz, 2H), 6.33-6.37 (m, 2H), 5.54 (d, *J* = 9.4 Hz, 1H), 5.08 (ddd, *J* = 9.4, 4.4, 1.9 Hz, 1H), 4.31 (dd, *J* = 15.0, 4.4 Hz, 1H), 3.76 (dd, *J* = 15.0, 1.9 Hz, 1H), 3.54 (br s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 150.9, 143.2, 137.3, 136.6, 121.8, 121.1, 119.1, 118.6, 110.8, 108.7, 87.1, 55.3, 48.5; HRMS (ES^+, Ar) calcd for $C_{13}H_{13}N_3O_3Na$ (MNa^+) 282.0849, found 282.0850.

3-Nitro-2-phenyl-2,3,4,5-tetrahydro-1H-benzo[b][1,4]-diazepine (3b). Yellow sticky solid; Yield 108 mg, 80%, dr 91:09; Major isomer (minor isomer could not be isolated in pure form): mp 80 °C; IR (film, cm^{-1}) 3392 (br s), 3053 (w), 2917 (w), 1599 (s), 1544 (vs), 1505 (m), 1458 (m), 1352 (m), 1314 (s), 1266 (m), 1254 (m), 739 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ

7.39-7.47 (m, 5H), 6.83 (td, *J* = 7.6, 1.3 Hz, 1H), 6.77 (td, *J* = 7.6, 1.3 Hz, 1H), 6.69 (dd, *J* = 7.6, 1.3 Hz, 1H), 6.59 (dd, *J* = 7.6, 1.3 Hz, 1H), 5.23 (d, *J* = 9.7 Hz, 1H), 4.97 (ddd, *J* = 9.7, 4.3, 2.9 Hz, 1H), 4.33 (dd, *J* = 14.6, 4.3 Hz, 1H), 3.77 (br s, 1H), 3.66 (dd, *J* = 14.6, 2.9 Hz, 1H), 3.38 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 139.0, 137.6, 137.5, 129.5, 129.3, 127.5, 121.9, 121.4, 119.4, 119.1, 90.6, 62.6, 49.3; HRMS (ES^+, Ar) calcd for $C_{15}H_{15}N_3O_2Na$ (MNa^+) 292.1056, found 292.1058.

3-Nitro-2-p-tolyl-2,3,4,5-tetrahydro-1H-benzo[b][1,4]-diazepine (3c). Yellow solid; Yield 112 mg, 79%, dr >95:5; mp 146 °C; IR (film, cm^{-1}) 3366 (br m), 2917 (w), 1598 (m), 1536 (m), 1505 (m), 1462 (s), 1342 (m), 1311 (s), 1251 (vs), 1274 (w), 1180 (w), 1024 (m), 835 (w), 751 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.33 (d, *J* = 7.5 Hz, 2H), 7.21 (d, *J* = 7.5 Hz, 2H), 6.82 (td, *J* = 7.6, 1.5 Hz, 1H), 6.76 (td, *J* = 7.6, 1.5 Hz, 1H), 6.71 (dd, *J* = 7.6, 1.5 Hz, 1H), 6.59 (dd, *J* = 7.6, 1.5 Hz, 1H), 5.14 (d, *J* = 9.7 Hz, 1H), 4.97 (ddd, *J* = 9.7, 4.3, 3.3 Hz, 1H), 4.31 (dd, *J* = 14.6, 4.3 Hz, 1H), 3.66 (dd, *J* = 14.6, 3.3 Hz, 1H), 3.40 (br s, 2H), 2.36 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 139.1, 137.6, 137.5, 136.0, 130.0, 127.4, 121.8, 121.3, 119.3, 119.0, 90.6, 62.3, 49.3, 21.3; HRMS (ES^+, Ar) calcd for $C_{16}H_{17}N_3O_2Na$ (MNa^+) 306.1213, found 306.1210.

2-(4-Methoxyphenyl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine (3d). Yellow solid; Yield 126 mg, 84%, dr >95:5; mp 158 °C; IR (film, cm^{-1}) 3381 (br s), 2916 (w), 1600 (m), 1543 (s), 1514 (s), 1461 (s), 1354 (m), 1315 (s), 1251 (vs), 1179 (m), 1029 (m), 834 (s), 750 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.37 (td, *J* = 8.7, 1.9 Hz, 2H), 6.93, (td, *J* = 8.7, 1.9 Hz, 2H), 6.74 (dt, *J* = 7.5, 1.5 Hz, 1H), 6.79 (dt, *J* = 7.5, 1.5 Hz, 1H), 6.69 (dd, *J* = 7.5, 1.5 Hz, 1H), 5.59 (dd, *J* = 7.5, 1.5 Hz, 1H), 5.13 (d, *J* = 9.8 Hz, 1H), 4.89 (dt, *J* = 9.8, 2.6 Hz, 1H), 4.28 (dd, *J* = 14.4, 2.6 Hz, 1H), 3.81 (s, 3H), 3.77 (br s, 1H), 3.64 (dd, *J* = 14.4, 2.6 Hz, 1H), 3.32 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 160.1, 137.7, 137.5, 131.0, 128.7, 121.8, 121.4, 119.3, 119.1, 114.7, 90.8, 62.1, 55.5, 49.3; HRMS (ES^+, Ar) calcd for $C_{16}H_{17}N_3O_3Na$ (MNa^+) 322.1162, found 322.1162.

2-(3,4-Dimethoxyphenyl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine (3e). Yellow solid; Yield 135 mg, 82%, dr >95:5; mp 175 °C; IR (film, cm^{-1}) 3387 (br m), 2912 (w), 1611 (m), 1600 (m), 1543 (vs), 1514 (s), 1460 (m), 1353 (m), 1315 (s), 1252 (vs), 1179 (m), 1031 (m), 833 (m), 750 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 6.97 (dd, *J* = 8.2, 2.0 Hz, 1H), 6.94 (d, *J* = 2.0 Hz, 1H), 6.86 (d, *J* = 8.2 Hz, 1H), 6.82 (td, *J* = 7.5, 1.6 Hz, 1H), 6.76 (td, *J* = 7.5, 1.6 Hz, 1H), 6.69 (dd, *J* = 7.5, 1.6 Hz, 1H), 6.62 (dd, *J* = 7.5, 1.6 Hz, 1H), 5.11 (d, *J* = 9.7 Hz, 1H), 4.92 (dt, *J* = 9.7, 3.5 Hz, 1H), 4.26 (br d, *J* = 13.9 Hz, 1H), 3.89 (s, 3H), 3.88 (s, 3H), 3.78 (br s, 1H), 3.62 (br d, *J* = 13.9 Hz, 1H), 3.37 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 149.7, 149.6, 137.7, 137.6, 131.4, 122.0, 121.5, 119.9, 119.5, 119.2, 111.6, 110.3, 90.8, 62.5, 56.2, 56.1, 49.4; HRMS (ES^+, Ar) calcd for $C_{17}H_{19}N_3O_4Na$ (MNa^+) 352.1268, found 352.1268.

2-(Benzo[d][1,3]dioxol-5-yl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine (3f). Yellow solid; Yield 125 mg, 80%, dr >95:5; mp 129 °C; IR (film, cm^{-1}) 3382 (br s), 2903 (w), 1600 (m), 1544 (vs), 1505 (m), 1353 (w), 1314 (m), 1249 (vs), 1089 (m), 1038 (s), 931 (m), 749 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 6.92 (d, *J* = 1.7 Hz, 1H), 6.89 (dd, *J* = 7.9, 1.7 Hz, 1H), 6.80 (d, *J* = 7.9 Hz, 1H), 6.78 (td, *J* = 7.6, 1.5 Hz, 1H), 6.76 (td, *J* = 7.6, 1.5 Hz, 1H), 6.68 (dd, *J* = 7.6, 1.5 Hz, 1H), 6.59 (dd, *J* = 7.6, 1.5 Hz, 1H), 5.98 (s, 2H), 5.10 (d, *J* = 9.7 Hz, 1H), 4.89 (ddd, *J* = 9.7, 4.3, 2.9 Hz, 1H), 4.27 (dd, *J* = 14.6, 4.3 Hz, 1H), 3.62 (dd, *J* = 14.6, 2.9 Hz, 1H), 3.30 (br s, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 148.5, 148.3, 137.6, 137.5, 132.7, 122.0, 121.5, 121.3, 119.4, 119.2, 108.9, 107.6, 101.6, 90.8, 62.5, 49.3; HRMS (ES^+, Ar) calcd for $C_{16}H_{15}N_3O_4Na$ (MNa^+) 336.0955, found 336.0964.

2-(4-Chlorophenyl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo-[b][1,4]diazepine (3g). Yellow solid; Yield 123 mg, 81%, dr >95:5; mp 164 °C; IR (film, cm^{-1}) 3389 (br s), 3056 (w), 2916 (w), 1599 (s), 1543 (vs), 1505 (s), 1492 (s), 1459 (s), 1353 (s), 1315 (s), 1091 (s), 828 (s), 748 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.35-7.45 (m, 4H), 6.83 (dt, *J* = 7.6, 1.4 Hz, 1H), 6.77 (dt, *J* = 7.6, 1.4 Hz, 1H), 6.69 (dd, *J* = 7.6, 1.4 Hz, 1H), 6.59 (dd, *J* = 7.6, 1.4 Hz, 1H), 5.19 (d, *J* = 9.7 Hz, 1H), 4.87 (ddd, *J* = 9.7, 4.3, 3.0 Hz, 1H), 4.31 (dd, *J* = 14.6, 4.3 Hz, 1H), 3.67 (dd, *J* = 14.6, 3.0 Hz, 1H), 3.28 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 137.5, 137.4, 137.3, 135.1, 129.7, 128.9, 122.1, 121.4, 119.4, 119.0, 90.5, 61.9, 49.3; HRMS (ES^+, Ar) calcd for $C_{15}H_{14}ClN_3O_2Na$ (MNa^+) 326.0667, found 326.0668; Selected X-ray data (CCDC 1941084): $C_{15}H_{14}ClN_3O_2$, M=303.74, Monoclinic, space group P2(1)/n, a = 10.060(3) Å, b = 15.488(4) Å, c = 10.075(3) Å, α = 90°, β = 118.231(4)°, γ = 90°, V=1383.0(7) $Å^3$, Z= 4, Dx = 1.459 Mg/m^3, F(000)= 632, λ = 0.71073 Å, μ = 0.284 mm^{-1}, total/unique= 9917/ 2462 [R(int) = 0.0671], T=100(2) K, θ range= θmax = 25.29°, θmin = 4.16°, final R[I>2σ(I)]: R1 = 0.0386, wR2 = 0.1017, R(all data): R1 = 0.0425, wR2 = 0.1054.

2-(2-Chlorophenyl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo-[b][1,4]diazepine (3h). dr 75:25 (a) Major isomer (**3h**): Yellow solid; Yield 98 mg, 65%; mp 166 °C; IR (film, cm^{-1}) 3395 (br m), 3060 (w), 2917 (w), 1600 (m), 1544 (vs), 1505 (m), 1458 (m), 1353 (s), 1315 (m), 750 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.51-6.55 (m, 1H), 7.44-7.48 (m, 1H), 7.28-7.36 (m, 2H), 6.82 (td, *J* = 7.4, 1.1 Hz, 1H), 6.77 (td, *J* = 7.4, 1.1 Hz, 1H), 6.68 (dd, *J* = 7.4, 1.1 Hz, 1H), 6.62 (dd, *J* = 7.4, 1.1 Hz, 1H), 5.73 (d, *J* = 9.8 Hz, 1H), 5.22 (ddd, *J* = 9.8, 4.2, 3.0 Hz, 1H), 4.34 (dd, *J* = 14.6, 4.2 Hz, 1H), 3.75 (dd, *J* = 14.6, 3.0 Hz, 1H), 2 NH protons are not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 137.6, 137.4, 136.0, 134.4, 130.8, 130.2, 128.4, 127.8, 122.0, 121.3, 119.4, 118.9, 87.8, 58.8, 49.1; HRMS (ES^+, Ar) calcd for $C_{15}H_{14}ClN_3O_2Na$ (MNa^+) 326.0667, found 326.0668.

(b) Minor isomer (**3h'**): Yellow solid; Yield 32 mg, 21%; mp 167 °C; IR (film, cm^{-1}) 3394 (br s), 3060 (w), 2916 (w), 1599 (m), 1544 (vs), 1505 (m), 1459 (m), 1353 (m), 1315 (m), 1253 (w), 1089 (w), 751 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.41-7.44 (m, 2H), 7.28-7.36 (m, 2H), 6.90-6.96 (unresolved m, 1H), 6.83-6.88 (unresolved m, 2H), 6.73-6.78 (unresolved m, 1H), 5.66 (d, *J* = 3.9 Hz, 1H), 5.31-5.37 (m, 1H), 4.43 (dd, *J* = 13.4, 9.4 Hz, 1H), 3.82 (dd, *J* = 13.4, 5.5 Hz, 1H), 2 NH protons are not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 138.4, 136.5, 135.0, 132.5, 129.9, 129.8, 128.0, 126.8, 122.2, 121.5, 121.0, 118.8, 85.9, 57.9, 48.0; HRMS (ES^+, Ar) calcd for $C_{15}H_{14}ClN_3O_2Na$ (MNa^+) 326.0667, found 326.0659.

2-(3-Bromophenyl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo-[b][1,4]diazepine (3i). Yellow solid; Yield 132 mg, 76%, dr 92:08; Major isomer (minor isomer could not be isolated in pure form): mp 191 °C, IR (film, cm^{-1}) 3394 (br s), 3053 (m), 2921 (w), 1599 (s), 1544 (vs), 1458 (s), 1352 (m), 1314 (s), 1265 (s), 804 (m), 778 (s), 737 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.62 (t, *J* = 1.6 Hz, 1H), 7.52 (dt, *J* = 8.1, 1.6 Hz, 1H), 7.38 (d, *J* = 7.8 Hz, 1H), 7.29 (t, *J* = 8.1 Hz, 1H), 6.82 (td, *J* = 7.6, 1.5 Hz, 1H), 6.76 (td, *J* = 7.6, 1.5 Hz, 1H), 6.67 (dd, *J* = 7.6, 1.5 Hz, 1H), 6.59 (dd, *J* = 7.6, 1.5 Hz, 1H), 5.20 (d, *J* = 9.6 Hz, 1H), 4.90 (ddd, *J* = 9.6, 4.3, 2.8 Hz, 1H), 4.34 (dd, *J* = 14.7, 4.3 Hz, 1H), 3.69 (dd, *J* = 14.7, 2.8 Hz, 1H), 3.29 (br s, 1H), 1 NH proton is not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 141.2, 137.5, 137.2, 132.5, 131.0, 130.6, 126.4, 123.4, 122.1, 121.4, 119.4, 119.0, 90.2, 62.0, 49.2;

HRMS (ES^+, Ar) calcd for $C_{15}H_{14}N_3O_2BrNa$ (MNa^+) 370.0162, found 370.0163.

3-Nitro-2-(2-nitrophenyl)-2,3,4,5-tetrahydro-1H-benzo-[*b*][1,4]diazepine (3j). Major + Minor: Yellow solid; 118 mg, 75%; dr 80:20; Major isomer (minor isomer could not be isolated in pure form): Yellow solid; Yield 95 mg, 60%; mp 169-171 ^oC; IR (film, cm^{-1}) 3390 (br s), 2924 (m), 2853 (w), 1542 (s), 1527 (s), 1506 (w), 1459 (w), 1354 (m), 1264 (w), 745 (s); ^1H NMR ($CDCl_3$, 400 MHz) δ 7.61-7.63 (unresolved m, 1H), 7.52 (d, *J* = 7.8 Hz, 1H), 7.38 (d, *J* = 7.8 Hz, 1H), 7.27 (t, *J* = 7.8 Hz, 1H), 6.82 (t, *J* = 7.6 Hz, 1H), 6.75 (t, *J* = 7.6 Hz, 1H), 6.67 (d, *J* = 7.6 Hz, 1H), 6.60 (d, *J* = 7.6 Hz, 1H), 5.20 (d, *J* = 9.6 Hz, 1H), 4.90 (ddd, *J* = 9.6, 4.2, 3.6 Hz, 1H), 4.34 (dd, *J* = 14.6, 4.2 Hz, 1H), 3.69 (dd, *J* = 14.6, 3.6 Hz, 1H), 3.28 (br s, 1H), 1 NH proton is not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 141.2, 137.5, 137.2, 132.5, 131.0, 130.6, 126.4, 123.4, 122.1, 121.4, 119.4, 119.0, 90.3, 62.0, 49.3; HRMS (ES^+, Ar) calcd for $C_{15}H_{14}N_4O_4$ (MH^+) 315.1088, found 315.1087.

3-Nitro-2-(thiophen-2-yl)-2,3,4,5-tetrahydro-1H-benzo-[b][1,4]diazepine (3k). Yellow solid; Yield 94 mg, 68%, dr 94:06; Major isomer (minor isomer could not be isolated in pure form): mp 81 ^oC; IR (film, cm^{-1}) 3388 (br s), 2919 (w), 1599 (m), 1544 (vs), 1505 (s), 1459 (s), 1354 (m), 1315 (s), 1089 (m), 750 (s); ^1H NMR ($CDCl_3$, 400 MHz) δ 7.33 (dd, *J* = 5.1, 0.7 Hz, 1H), 7.12 (dd, *J* = 3.5, 0.7 Hz, 1H), 7.00 (dd, *J* = 5.1, 3.5 Hz, 1H), 6.82 (td, *J* = 7.5, 1.6 Hz, 1H), 6.76 (td, *J* = 7.5, 1.6 Hz, 1H), 6.67 (dd, *J* = 7.5, 1.6 Hz, 1H), 6.62 (dd, *J* = 7.5, 1.6 Hz, 1H), 5.59 (d, *J* = 9.6 Hz, 1H), 4.94, 4.91 (ddd, *J* = 9.5, 4.4, 2.7 Hz, 1H), 4.31 (dd, *J* = 14.8, 4.4 Hz, 1H), 3.80 (br s, 1H), 3.68 (dd, *J* = 14.8, 2.7 Hz, 1H), 3.43 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 141.2, 137.5, 136.9, 127.3, 126.8, 126.1, 122.1, 121.3, 119.5, 119.0, 91.3, 57.7, 49.1; HRMS (ES^+, Ar) calcd for $C_{13}H_{13}N_3O_2SNa$ (MNa^+) 298.0621, found 298.0617.

4-(Furan-2-yl)-7/8-methyl-3-nitro-2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine (4ab + 5ab). Yellow semi-solid, Yield 114 mg, 84% (1:1 ratio, inseparable, dr >95:5); IR (film, cm^{-1}) 3391 (br s), 3053 (w), 2920 (w), 2920 (m), 1599 (s), 1543 (vs), 1506 (s), 1459 (s), 1353 (m), 1315 (s), 1281 (m), 1253 (s), 1086 (w), 1031 (w), 778 (m), 747 (s); ^1H NMR ($CDCl_3$, 400 MHz) δ 7.42-7.44 (unresolved m, 1H), 6.59, 6.57 (ABqd, *J* = 8.2, 0.9 Hz, 1H), 6.55, 6.52 (ABq, *J* = 7.7 Hz, 1H), 6.43-6.45 (unresolved m, 1H), 6.35-6.37 (m, 1H), 6.32-6.34 (m, 1H), 5.50 (d, *J* = 9.4 Hz, 0.5H), 5.45 (d, *J* = 9.4 Hz, 0.5H), 5.06 (ddd, *J* = 9.4, 4.4, 2.0 Hz, 0.5H), 5.03 (ddd, *J* = 9.4, 4.4, 2.0 Hz, 0.5H), 4.26 (dd, *J* = 15.0, 4.4 Hz, 0.5H), 4.22 (dd, *J* = 15.0, 4.4 Hz, 0.5H), 3.72 (dt, *J* = 15.0, 2.0 Hz, 1H), 3.45 (br s, 2H), 2.22 (s, 1.5H), 2.20 (s, 1.5H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 151.1, 151.0, 143.1, 143.0, 137.3, 136.6, 134.8, 134.2, 131.4, 130.7, 122.3, 121.6, 119.7, 119.2, 119.1, 118.8, 110.8, 110.7, 108.6, 108.5, 87.4, 55.6, 55.3, 48.8, 48.5, 20.6, 20.5; HRMS (ES^+, Ar) calcd for $C_{14}H_{15}N_3O_3Na$ (MNa^+) 296.1006, found 296.1002.

7/8-Chloro-4-(furan-2-yl)-3-nitro-2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine (4ac + 5ac). Yellow semi-solid, Yield 111 mg, 76% (1:1 ratio, inseparable, dr >95:5); IR (film, cm^{-1}) 3398 (br s), 3124 (m), 2921 (m), 2855 (w), 1597 (m), 1551 (s), 1499 (m), 1352 (m), 1310 (s), 1284 (m), 1086 (m), 807 (s), 745 (vs); ^1H NMR ($CDCl_3$, 400 MHz) δ 7.43 (d, *J* = 0.7 Hz, 1H), 6.72 (dd, *J* = 8.3, 2.2 Hz, 0.5H), 6.67 (dd, *J* = 8.3, 2.2 Hz, 0.5H), 6.59 (d, *J* = 2.2 Hz, 1H), 6.53 (d, *J* = 8.3 Hz, 0.5H), 6.50 (d, *J* = 8.3 Hz, 0.5H), 6.35-6.37 (m, 1H), 6.32-6.34 (m, 1H), 5.53 (d, *J* = 9.2 Hz, 0.5H), 5.48 (d, *J* = 9.2 Hz, 0.5H), 5.05 (ddd, *J* = 9.2, 4.2, 2.7 Hz, 0.5H), 5.02 (ddd, *J* = 9.2, 4.2, 2.7 Hz, 0.5H), 4.30 (td, *J* = 14.8, 4.2 Hz, 1H), 3.76 (dd, *J* = 14.8, 2.7 Hz, 1H), 3.51 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 150.6, 150.4, 143.3, 143.2, 138.3, 137.5, 135.9, 135.2, 126.3, 125.4, 121.3, 120.6, 119.9, 119.4, 118.6, 118.1, 110.8, 110.8, 108.8, 108.7, 86.8, 86.7, 55.2, 55.0, 48.3, 48.0; HRMS (ES^+, Ar) calcd for $C_{13}H_{12}ClN_3O_3Na$ (MNa^+) 316.0459, found 316.0457.

4-(2-Chlorophenyl)-3-nitro-1-phenyl-2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine (6h). Yellow solid; Yield 136 mg, 72%, dr 88:12 (minor isomer could not be isolated in pure form); Major isomer: mp 166 ^oC; IR (film, cm^{-1}) 3392 (br w), 3059 (w), 2925 (vw), 1592 (m), 1578 (w), 1546 (s), 1499 (m), 1475 (w), 1358 (w), 1298 (w), 752 (vs); ^1H NMR ($CDCl_3$, 400 MHz) δ 7.54-7.65 (m, 2H), 7.35-7.45 (m, 4H), 7.18-7.26 (m, 2H), 7.03-7.10 (m, 3H), 6.70-7.02 (m, 2H), 5.62 (d, *J* = 10.0 Hz, 1H), 5.40 (ddd, *J* = 10.0, 5.8, 4.1 Hz, 1H), 4.83 (dd, *J* = 15.4, 4.1 Hz, 1H), 4.54 (dd, *J* = 15.4, 5.8 Hz, 1H), 3.49 (br s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 147.2, 143.8, 136.2, 135.7, 134.5, 130.7, 130.3, 129.7, 128.0, 127.8, 127.7, 126.3, 122.7, 121.1, 120.3, 117.0, 85.8, 58.6, 52.5; HRMS (ES^+, Ar) calcd for $C_{21}H_{19}N_3O_2Cl$ (MH^+) 380.1160, found 380.1155.

(*E*)-N^1-(3-(Furan-2-yl)-2-nitroallyl)-N^2-phenylbenzene-1,2-diamine (7a). Yellow solid; Yield 143 mg, 85%; mp 152 ^oC; IR (film, cm^{-1}) 3374 (br m), 3047 (w), 1597 (s), 1509 (s), 1500 (s), 1308 (vs), 1022 (w), 930 (w), 748 (vs); ^1H NMR ($CDCl_3$, 400 MHz) δ 7.88 (s, 1H), 7.53-7.55 (unresolved m, 1H), 7.13-7.21 (m, 3H); 6.98-7.03 (m, 1H), 6.88-6.94 (m, 2H), 6.76-6.84 (m, 2H), 6.69-6.73 (m, 2H), 6.57 (dd, *J* = 3.5, 1.8 Hz, 1H), 4.81 (s, 2H), 2 NH protons are not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 147.4, 147.2, 145.6, 145.1, 142.6, 129.8, 129.4, 125.8, 124.7, 122.8, 121.8, 119.5, 119.0, 115.5, 113.4, 113.1, 40.6; HRMS (ES^+, Ar) calcd for $C_{19}H_{18}N_3O_3$ (MH^+) 336.1348, found 336.1334.

(*E*)-N^1-(2-Nitro-3-p-tolylallyl)-N^2-phenylbenzene-1,2-diamine (7c). Yellow solid; Yield 133 mg, 74%; mp 142 ^oC; IR (film, cm^{-1}) 3378 (br s), 3048 (w), 2921 (w), 1644 (w), 1601 (s), 1545 (w), 1498 (s), 1312 (w), 1279 (w), 819 (w), 747 (s); ^1H NMR ($CDCl_3$, 400 MHz) δ 8.19 (s, 1H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.26 (d, *J* = 8.0 Hz, 2H), 7.14-7.22 (m, 3H), 7.03 (td, *J* = 7.6, 1.0 Hz, 1H), 6.84 (td, *J* = 7.6, 1.0 Hz, 1H), 6.78 (dd, *J* = 7.6, 1.0 Hz, 1H), 6.71-6.76 (m, 2H), 6.55 (dd, *J* = 7.6, 1.0 Hz, 1H), 5.00-5.15 (br s, 1H), 4.45 (s, 2H), 2.4 (s, 3H), 1 NH proton is not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 147.5, 145.4, 142.2, 141.7, 137.6, 130.3, 130.1, 129.4, 128.8, 125.7, 124.4, 119.8, 119.2, 115.9, 112.6, 40.8, 21.7; HRMS (ES^+, Ar) calcd for $C_{22}H_{22}N_3O_2$ (MH^+) 360.1712, found 360.1696.

(*E*)-N^1-(3-(4-Methoxyphenyl)-2-nitroallyl)-N^2-phenyl-benzene-1,2-diamine (7d). Yellow solid; Yield 95 mg, 85%; mp 120 ^oC; IR (film, cm^{-1}) 3365 (br m), 2927 (w), 1603 (vs), 1545 (m), 1512 (vs), 1305 (m), 1257 (vs), 1178 (s), 1028 (m), 749 (s); ^1H NMR ($CDCl_3$, 400 MHz) δ 8.19 (s, 1H), 7.45 (d, *J* = 8.8 Hz, 2H), 7.19 (overlapped t, *J* = 8.4 Hz, 2H), 7.18 (overlapped t, *J* = 8.0 Hz, 1H), 7.05 (t, *J* = 8.4 Hz, 1H), 6.95 (d, *J* = 8.8 Hz, 2H), 6.82 (t, *J* = 8.0 Hz, 1H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.74 (d, *J* = 8.4 Hz, 2H), 6.62 (d, *J* = 8.0 Hz, 1H), 5.14 (br s, 1H), 4.54 (br s, 1H), 4.45 (s, 2H), 3.86 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 162.1, 146.1, 145.4, 142.4, 137.7, 132.5, 130.1, 129.4, 125.8, 124.3, 124.0, 119.8, 119.2, 115.9, 114.9, 112.5, 55.6, 41.0; HRMS (ES^+, Ar) calcd for $C_{22}H_{22}N_3O_3$ (MH^+) 376.1656, found 376.1654.

(*E*)-N^1-(3-(Benzo[d][1,3]dioxol-5-yl)-2-nitroallyl)-N^2-phenylbenzene-1,2-diamine (7f). Yellow solid; Yield 152 mg, 78%; mp 150 ^oC; IR (film, cm^{-1}) 3380 (br w), 3060 (vw), 2913 (w), 1643 (w), 1598 (s), 1501 (vs), 1310 (m), 1247 (s), 1037 (s), 747 (vs); ^1H NMR ($CDCl_3$, 400 MHz) δ 8.14 (s, 1H), 7.15-7.19 (m, 3H), 7.01-7.08 (m, 3H), 6.77-6.89 (m, 3H), 6.74 (d, *J* = 7.7 Hz, 2H), 6.62 (d, *J* = 8.0 Hz, 1H), 6.04 (s, 2H), 5.15 (br s, 1H),

4.42 (s, 2H), 1 NH proton is not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 150.3, 148.7, 146.5, 145.4, 142.3, 137.7, 130.1, 129.4, 126.4, 125.8, 125.5, 124.4, 119.8, 119.3, 115.9, 112.5, 109.8, 109.2, 102.1, 41.0; HRMS (ES^+, Ar) calcd for $C_{22}H_{20}N_3O_4$ (MH^+) 390.1454, found 390.1464.

(*E*)-N^1-(3-(4-Chlorophenyl)-2-nitroallyl)-N^2-phenylbenzene-1,2-diamine (7g). Dark yellow solid; Yield 80 mg, 70%; mp 139 ^{o}C; IR (film, cm^{-1}) 3374 (br m), 3053 (w), 2927 (w), 1595 (s), 1546 (m), 1496 (vs), 1319 (s), 1092 (m), 749 (vs); ^{1}H NMR ($CDCl_3$, 500 MHz) δ 8.14 (s, 1H), 7.42, 7.38 (ABq, *J* = 8.5 Hz, 4H), 7.20 (t, *J* = 7.8 Hz, 2H), 7.15 (d, *J* = 8.0 Hz, 1H), 7.02 (t, *J* = 7.8 Hz, 1H), 6.84 (t, *J* = 8.0 Hz, 1H), 6.79 (t, *J* = 8.0 Hz, 1H), 6.72 (d, *J* = 7.8 Hz, 2H), 6.53 (d, *J* = 8.0 Hz, 1H), 5.14 (br s, 1H), 4.56 (br s, 1H), 4.40 (d, *J* = 4.0 Hz, 2H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 148.6, 145.3, 142.0, 137.2, 136.0, 131.4, 130.2, 130.1, 129.7, 129.4, 125.8, 124.5, 119.9, 119.5, 115.9, 112.7, 40.8; HRMS (ES^+, Ar) calcd for $C_{21}H_{19}ClN_3O_2$ (MH^+) 380.1160, found 380.1164.

(*E*)-N^1-(2-Nitro-3-(2-nitrophenyl)allyl)-N^2-phenylbenzene-1,2-diamine (7j). Yellow solid; Yield 83 mg, 71%; mp 155 ^{o}C; IR (film, cm^{-1}) 3373 (br m), 2922 (m), 2853 (w), 1597 (m), 1524 (vs), 1497 (m), 1343 (m), 749 (m); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.46 (s, 1H), 8.26 (d, *J* = 8.0 Hz, 1H), 7.66 (t, *J* = 8.0 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 1H), 7.19 (d, *J* = 7.6 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 1H), 6.92 (t, *J* = 7.6 Hz, 1H), 6.84 (t, *J* = 8.0 Hz, 1H), 6.75 (t, *J* = 8.0 Hz, 1H), 6.68 (d, *J* = 7.6 Hz, 2H), 6.38 (d, *J* = 8.0 Hz, 1H), 5.15 (s, 1H), 4.51 (br s, 1H), 4.25 (d, *J* = 5.2 Hz, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 149.1, 147.3, 145.2, 141.5, 134.4, 134.3, 131.0 (× 2), 130.4, 129.4, 128.0, 125.6, 125.4, 124.2, 119.9, 115.8 (× 2), 113.3, 40.8; HRMS (ES^+, Ar) calcd for $C_{21}H_{18}KN_4O_4$ (MK^+) 429.0960, found 429.0958.

(*E*)-N^1-(2-Nitro-3-(3,4,5-trimethoxyphenyl)allyl)-N^2-phenylbenzene-1,2-diamine (7l). Red solid; Yield 105 mg, 81%; mp 130 ^{o}C; IR (film, cm^{-1}) 3358 (br m), 2936 (m), 1593 (s), 1547 (m), 1498 (s), 1463 (m), 1420 (m), 1316 (m), 1240 (m), 1128 (vs), 1004 (m), 748 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.16 (s, 1H), 7.19 (t, *J* = 8.0 Hz, 2H), 7.16 (t, *J* = 7.6 Hz, 1H), 7.04 (t, *J* = 8.0 Hz, 1H), 6.83 (t, *J* = 7.6 Hz, 1H), 6.80 (d, *J* = 7.6 Hz, 1H), 6.76 (s, 2H), 6.74 (d, *J* = 8.0 Hz, 2H), 6.65 (d, *J* = 7.6 Hz, 1H), 5.17 (br s, 1H), 4.60 (br s, 1H), 4.43 (d, *J* = 4.8 Hz, 2H), 3.90 (s, 3H), 3.71 (s, 6H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 153.6, 147.2, 145.3, 142.1, 140.6, 137.9, 130.0, 129.4, 126.9, 125.6, 124.1, 119.9, 119.3, 115.8, 112.2, 107.6, 61.1, 56.1, 41.2; HRMS (ES^+, Ar) calcd for $C_{24}H_{26}N_3O_5$ (MH^+) 436.1867, found 436.1875.

(*E*)-N^1-(3-(Naphthalen-1-yl)-2-nitroallyl)-N^2-phenylbenzene-1,2-diamine (7m). Brown solid; Yield 85 mg, 72%; mp 159 ^{o}C; IR (film, cm^{-1}) 3375 (br m), 3048 (w), 1652 (w), 1596 (s), 1521 (vs), 1445 (m), 1330 (s), 1266 (m), 748 (vs); ^{1}H NMR ($CDCl_3$, 500 MHz) δ 8.73 (s, 1H), 7.98 (d, *J* = 8.1 Hz, 1H), 7.95 (d, *J* = 7.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.56-7.64 (m, 2H), 7.51 (t, *J* = 7.5 Hz, 1H), 7.45 (d, *J* = 7.5 Hz, 1H), 7.19 (t, *J* = 7.9 Hz, 2H), 7.05 (d, *J* = 7.3 Hz, 1H), 6.83 (t, *J* = 7.3 Hz, 1H), 6.63-6.70 (m, 4H), 6.21 (d, *J* = 7.3 Hz, 1H), 5.0 (br s, 1H), 4.67 (br s, 1H), 4.44 (s, 2H); ^{13}C NMR ($CDCl_3$, 126 MHz) δ 149.8, 145.5, 142.0, 135.3, 133.6, 131.5, 131.1, 129.6, 129.4, 129.0 (× 2), 127.6, 127.5, 127.0, 125.8, 125.5, 124.8, 124.5, 119.7, 119.0, 115.6, 112.5, 40.5; HRMS (ES^+, Ar) calcd for $C_{25}H_{22}N_3O_2$ (MH^+) 396.1707, found 396.1702.

(*E*)-N^1-(3-(2,5-Dimethoxyphenyl)-2-nitroallyl)-N^2-phenylbenzene-1,2-diamine (7n). Yellow solid; Yield 103 mg, 85%; mp 151-153 ^{o}C; IR (film, cm^{-1}) 3367 (br vs), 3044 (vw), 2942 (w), 2835 (w), 1595 (s), 1543 (w), 1496 (vs), 1461 (m), 1418 (w), 1301 (s), 1025 (vs), 745 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.36 (s, 1H), 7.19 (t, *J* = 7.6 Hz, 2H), 7.13 (d, *J* = 8.3 Hz, 1H), 6.94-7.02 (m, 3H), 6.88 (d, *J* = 8.3 Hz, 1H), 6.82 (t, *J* = 7.8 Hz, 1H), 6.75 (d, *J* = 7.8 Hz, 1H), 6.71 (d, *J* = 7.6 Hz, 2H), 6.55 (d, *J* = 7.8 Hz, 1H), 5.11 (br s, 1H), 4.61 (t, *J* = 6.0 Hz, 1H), 4.39 (d, *J* = 6.0 Hz, 2H), 3.81 (s, 3H), 3.61 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 153.6, 152.7, 148.0, 145.5, 142.3, 133.5, 129.9, 129.4, 125.7, 124.3, 121.3, 119.8, 119.1, 118.4, 115.8, 114.9, 112.5, 112.3, 56.3, 55.7, 41.1; HRMS (ES^+, Ar) calcd for $C_{23}H_{23}N_3O_4Na$ (MNa^+) 428.1581, found 428.1581.

(*S*)-1-(Bis((*E*)-3-(furan-2-yl)-2-nitroallyl)amino)-3-phenylpropan-2-ol (8). The starting materials **1a** and **2e** were used in 2:1 ratio); Yellow solid, Yield 98 mg, 72%; mp 164 ^{o}C; IR (film, cm^{-1}) 3512 (br w), 3148 (br w), 3121 (br w), 2926 (w), 1649 (m), 1512 (s), 1312 (vs), 1023 (m), 753 (m); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.99 (s, 2H), 7.67 (unresolved m, 2H), 7.13-7.22 (m, 2H), 6.93-6.96 (m, 4H), 6.60 (ABq, *J* = 1.7 Hz, 2H), 4.41 (d, *J* = 13.9 Hz, 2H), 4.14 (d, *J* = 13.9 Hz, 2H), 3.63 (t, *J* = 11.0 Hz, 1H), 3.28-3.34 (m, 2H), 2.99-3.05 (m, 1H), 2.60 (br s, 1H), 2.48-2.58 (m, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 147.4, 147.2, 144.4, 138.4, 129.0, 128.7, 126.4, 123.9, 122.4, 113.5, 63.0, 60.2, 45.1, 31.5; HRMS (ES^+, Ar) calcd for $C_{23}H_{24}N_3O_7$ (MH^+) 454.1609, found 454.1611.

General procedure for the reaction of MBH-acetate 1 and 10 with aminoamide 2f. To a stirred solution of MBH acetate **1/10** (0.3 mmol) in methanol (1.5 mL) at room temperature was added **2f** (0.3 mmol). The reaction mixture was stirred till complete consumption of the starting materials (monitored by TLC). The solvent was evaporated in *vacuo* and the crude residue was purified by silica gel column chromatography (20-40% EA / pet ether).

(*E*)-2-(3-(4-Methoxyphenyl)-2-nitroallylamino)benzamide (9d). Yellow solid; Yield 88 mg, 90%; mp 171 ^{o}C; IR (film, cm^{-1}) 3467 (br w), 3320 (br m), 1646 (s), 1603 (s), 1510 (s), 1305 (s), 1453 (w), 1384 (w), 1305 (s), 1256 (vs), 1177 (s), 1027 (m), 834 (m), 742 (m); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.26 (s, 1H), 7.45 (d, *J* = 8.7 Hz, 2H), 7.41 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.31 (td, *J* = 8.1, 1.4 Hz, 1H), 6.95 (d, *J* = 8.7 Hz, 2H), 6.67 (td, *J* = 8.1, 1.4 Hz, 1H), 6.61 (dd, *J* = 8.1, 1.4 Hz, 1H), 5.7 (br s, 1H), 4.52 (s, 2H), 3.85 (s, 3H), 2 NH protons are not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.9, 162.1, 149.4, 145.8, 137.8, 133.7, 132.5, 128.6, 123.9, 116.0, 115.0, 114.4, 112.3, 55.6, 40.0; HRMS (ES^+, Ar) calcd for $C_{17}H_{17}N_3O_4Na$ (MNa^+) 350.1111, found 350.1114.

(*E*)-2-((3-(4-Chlorophenyl)-2-nitroallyl)amino)benzamide (9g). Yellow solid; Yield 82 mg, 82%; mp 172 ^{o}C; IR (film, cm^{-1}) 3266 (br m), 2930 (w), 2861 (w), 1645 (m), 1578 (m), 1488 (m), 1396 (s), 1318 (vs), 1287 (vs), 1087 (m), 752 (vs); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.50 (t, *J* = 5.6 Hz, 1H), 8.28 (s, 1H), 7.87 (br s, 1H), 765, 7.60 (ABq, *J* = 8.7 Hz, 4H), 7.64 (overlapped d, *J* = 7.8 Hz, 1H), 7.21 (br s, 1H), 7.18 (t, *J* = 7.8 Hz, 1H), 6.60 (t, *J* = 7.8 Hz, 1H), 6.42 (d, *J* = 7.8 Hz, 1H), 4.45 (d, *J* = 5.6 Hz, 2H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.3, 148.6 (× 2), 135.6, 135.2, 132.5, 131.9, 130.2, 129.2, 129.1, 115.3, 115.0, 111.4, 79.1; HRMS (ES^+, Ar) calcd for $C_{16}H_{14}ClN_3O_3Na$ (MNa^+) 354.0616, found 354.0615.

(*E*)-2-(2-Nitro-3-(2-nitrophenyl)allylamino)benzamide (9j). Yellow solid; Yield 86 mg, 84%; mp 166 ^{o}C; IR (film, cm^{-1}) 3477 (br w), 3348 (br m), 2974 (w), 2925 (w), 1656 (s), 1615 (m), 1523 (vs), 1344 (s), 1095 (w), 753 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.49 (s, 1H), 8.21 (dd, *J* = 8.1, 1.0 Hz, 1H), 7.67 (td, *J* = 8.1, 1.0 Hz, 1H), 7.58 (td, *J* = 8.1, 0.8 Hz, 1H), 7.44 (d, *J* = 7.6 Hz, 1H), 7.30 (dd, *J* = 7.6, 1.4 Hz, 1H), 7.17 (td, *J* = 7.6, 1.4 Hz, 1H), 6.61 (t, *J* = 7.6 Hz, 1H), 6.36 (dd, *J* = 8.1, 0.8 Hz, 1H), 5.90

(br s, 2H), 4.39 (s, 2H), 1 NH proton is not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.8, 148.6, 148.5, 146.8, 134.4, 133.5, 130.9, 130.8, 128.5, 128.1, 125.4, 116.4, 114.3, 112.0, 39.8; HRMS (ES^+, Ar) calcd for $C_{16}H_{14}N_4O_5Na$ (MNa^+) 365.0856, found 365.0851.

(*E*)-2-((2-Nitro-3-(3,4,5-trimethoxyphenyl)allyl)amino)-benzamide (9l). Light yellow solid; Yield 93 mg, 80%; mp 169 °C; IR (film, cm^{-1}) 3415 (s), 3298 (m), 3170 (s), 3055 (m), 1672 (m), 1651 (m), 1621 (s), 1579 (m), 1504 (s), 1452 (m), 1392 (s), 1316 (vs), 1265 (vs), 1231 (m), 1156 (m), 990 (s); ^{1}H NMR ($CDCl_3$, 500 MHz) δ 8.23 (s, 1H), 8.17 (t, *J* = 4.5 Hz, 1H), 7.40 (d, *J* = 7.5 Hz, 1H), 7.31 (t, *J* = 7.5 Hz, 1H), 6.77 (s, 2H), 6.67 (t, *J* = 7.5 Hz, 1H), 6.65 (d, *J* = 7.5 Hz, 1H), 5.89 (br s, 2H), 4.47 (d, *J* = 4.5 Hz, 2H), 3.87 (s, 3H), 3.68 (s, 6H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 171.9, 153.6, 149.2, 146.9, 140.5, 138.4, 133.8, 128.6, 126.9, 116.2, 114.4, 112.1, 107.6, 61.1, 56.1, 40.3; HRMS (ES^+, Ar) calcd for $C_{19}H_{21}N_3NaO_6$ (MNa^+) 410.1323, found 410.1313.

(*E*)-2-((3-(Naphthalen-1-yl)-2-nitroallyl)amino)benzamide (9m). Yellow solid; Yield 81 mg, 77%; mp 171 °C; IR (film, cm^{-1}) 3313 (br m), 3186 (m), 1676 (m), 1648 (m), 1613 (m), 1571 (m), 1511 (m), 1385 (s), 1322 (vs), 1280 (s), 1254 (m), 750 (s), 733 (s), 524; ^{1}H NMR ($CDCl_3$, 500 MHz) δ 8.75 (s, 1H), 8.22 (t, *J* = 6.1 Hz, 1H), 7.96-7.80 (m, 1H), 7.92-7.96 (m, 1H), 7.85-7.89 (m, 1H), 7.55-7.61 (m, 2H), 7.51-7.54 (m, 2H), 7.32 (d, *J* = 8.0 Hz, 1H), 6.85 (t, *J* = 8.0 Hz, 1H), 6.52 (t, *J* = 8.0 Hz, 1H), 6.15 (d, *J* = 8.0 Hz, 1H), 5.69 (br s, 2H), 4.50 (d, *J* = 6.1 Hz, 2H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 171.8, 149.7, 148.9, 135.1, 133.6, 133.4, 131.6, 131.1, 129.0, 128.5, 127.7, 127.5, 127.0, 125.5, 124.5, 115.8, 114.3, 112.2, 39.5; HRMS (ES^+, Ar) calcd for $C_{20}H_{18}N_3O_3$ (MH^+) 348.1343, found 348.1348.

(*E*)-Ethyl 2-(2-carbamoylphenylamino)-4-(4-methoxy-phenyl)-3-nitrobut-3-enoate (11a). Yellow solid, 102 mg, 85%; mp 161 °C; IR (film, cm^{-1}) 3055 (w), 2926 (m), 2851 (w), 1754 (s), 1659 (s), 1606 (s), 1579 (m), 1513 (s), 1372 (w), 1265 (s), 1178 (s), 1027 (s), 739 (vs), 704 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.24 (s, 1H), 7.53 (d, *J* = 8.4 Hz, 2H), 7.41 (d, *J* = 7.7 Hz, 1H), 7.02 (d, *J* = 8.4 Hz, 2H), 7.00-7.05 (m, 1H), 6.59 (t, *J* = 7.7 Hz, 1H), 6.06 (brs, 1H), 5.91 (d, *J* = 7.7 Hz, 1H), 5.53 (s, 1H), 4.33 (q, *J* = 6.9 Hz, 2H), 3.89 (s, 3H), 1.31 (t, *J* = 6.9 Hz, 3H), 2 NH protons are not observed; ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.8, 171.7, 169.1, 162.0, 147.4, 146.4, 137.1, 133.2, 131.8, 128.9, 123.5, 116.5, 115.5, 115.0, 112.1, 62.8, 55.7, 53.4; HRMS (ES^+, Ar) calcd for $C_{20}H_{21}N_3O_6Na$ (MNa^+) 422.1323, found 422.1325.

(*Z*)-Ethyl 4-((2-carbamoylphenyl)amino)-4-(naphthalen-1-yl)-3-nitrobut-2-enoate (11b). Yellow solid; Yield 108 mg, 85%; mp 196 °C; IR (film, cm^{-1}) 3588 (br vs), 3007 (w), 2944 (w), 1637 (m), 1443 (m), 1376 (m), 1040 (m); ^{1}H NMR ($CDCl_3$, 500 MHz) δ 8.82 (s, 1H), 8.78 (d, *J* = 7.6 Hz, 1H), 8.03 (d, *J* = 8.0 Hz, 1H), 7.97 (d, *J* = 7.6 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.76 (d, *J* = 7.2 Hz, 1H), 7.53-7.66 (m, 3H), 7.32-7.28 (m, 1H), 6.48-6.44 (m, 2H), 5.75 (br s, 2H), 5.62-5.58 (m, 1H), 5.48 (d, *J* = 7.6 Hz, 1H), 4.47, 4.32 (ABqd, *J* = 10.6, 7.0 Hz, 2H), 1.38 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 171.4, 168.8, 149.0, 147.1, 135.8, 133.6, 133.0, 131.5 (× 2), 129.0, 128.6 (× 2), 127.7, 127.6, 127.2, 125.6, 124.6, 116.4, 115.4, 112.2, 63.0, 53.7, 14.3; HRMS (ES^+, Ar) calcd for $C_{23}H_{22}N_3O_5$ (MH^+) 420.1554, found 420.1550.

Procedure for the reaction of MBH acetate 12 with amine 2a.

To a stirred solution of MBH acetate **12** (0.5 mmol) in methanol (5 mL) at room temperature was added amino compound **2a** (0.5 mmol). The reaction mixture was stirred till complete consumption of the starting materials (monitored by TLC). The solvent was evaporated in *vacuo* and the crude residue was purified by silica gel column chromatography (10-20% EA / pet ether).

Ethyl 2,3,4,5-tetrahydro-1H-benzo[b][1,4]diazepine-3-carboxylate (13). Colorless liquid; Yield 39 mg, 35%; IR (film, cm^{-1}) 3376 (br s), 2978 (w), 2925 (m), 2855 (w), 1721 (vs), 1648 (m), 1598 (m), 1507 (s), 1315 (s), 749 (s); ^{1}H NMR ($CDCl_3$, 400 MHz) δ 6.73 (d, *J* = 3.6 Hz, 1H), 6.71 (t, *J* = 3.6 Hz, 1H), 6.66 (t, *J* = 3.6 Hz, 1H), 6.64 (d, *J* = 3.6 Hz, 1H), 4.17 (q, *J* = 7.1 Hz, 2H), 3.57 (dd, *J* = 13.1, 4.5 Hz, 2H), 3.40 (dd, *J* = 13.1, 7.5 Hz, 2H), 2.83 (tt, *J* = 7.5, 4.5 Hz, 1H), 1.27 (d, *J* = 7.1 Hz, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.1, 139.8, 121.2, 119.4, 60.8, 47.9, 47.0, 14.4; HRMS (ES^+, Ar) calcd for $C_{12}H_{16}N_2O_2K$ (MK^+) 259.0843, found 259.0847.

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Appendix A

Supporting Information Available. Copies of NMR spectra for all the new compounds and CIF for compound **3g**.

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Highlights

- Nitrobenzodiazepines have been synthesized from nitroallylic acetates for the first time
- The Nitroallylic acetates react as 1,3-bielectrophiles with 1,4-binucleophilic o-phenylenediamines in a [4+3] fashion
- The first step in the reaction of primary nitroallylic acetates has been confirmed to be S_N2 by isolating the intermediates
- The cascade reaction is highly stereoselective and takes place in MeOH at room temperature in the absence of any base or catalyst
- The intermediate SN2 products, N-nitroallylated compounds, possess multiple functionalities

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: