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The first diastereoselective nitroaziridination of *N*-tosylaldimines with 1-bromonitroalkanes

Lal Dhar S. Yadav *, Garima, Ritu Kapoor

Green Synthesis Lab, Department of Chemistry, University of Allahabad, Allahabad 211 002, India

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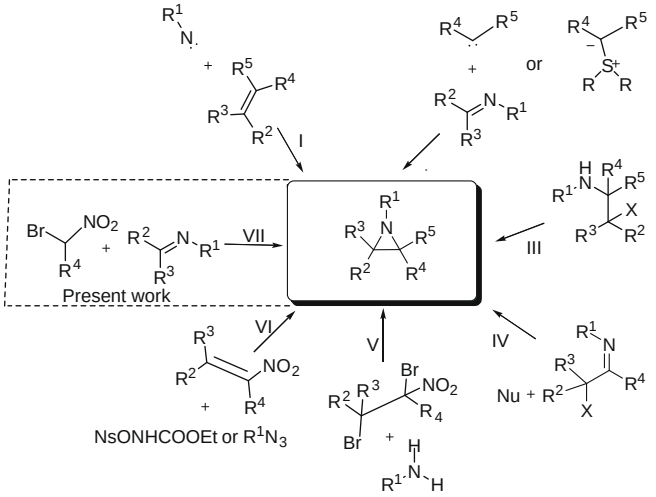
ABSTRACT

The first expeditious nitroaziridination of *N*-tosylaldimines is reported. The protocol involves operationally simple catalyst-free reaction of *N*-tosylaldimines, 1-bromonitroalkanes and NaOAc to afford 2-nitro-1-tosylaziridines in excellent yields with high *Z*-diastereoselectivity in a one-pot procedure under ambient conditions.

Owing to their highly regio- and stereoselective ring-opening reactions,[1–4] aziridines are valued as important building blocks for the synthesis of a wide range of nitrogen-containing compounds such as amino acids, amino sugars and alkaloids.[5] Besides their importance as reactive intermediates, aziridines are also incorporated in many biologically active compounds.[6] Antibiotic, anticancer and antitumour activities of aziridine-containing natural products, such as azinomycins,[7–9] mitomycins,[10,11] FR-900482, FR-66979 and related compounds,[12] are of significant interest. The bioactivity of all these compounds lies in the role of aziridines as powerful alkylating agents.[13] Furthermore, several synthetic aziridines have also been reported to exhibit useful biological properties such as irreversible inhibition of glutamate racemase[14] and diaminopimetic acids epimerase (DAP)[15] and high level cytotoxicity against melanoma cell lines.[16]

The development of procedures leading to the stereocontrolled formation of carbon–nitrogen bond is considered a challenging research target. Numerous methods are available for differently substituted aziridines, which include aziridination of olefins[17–19] (Scheme 1, route I), carbene and ylide addition to imines[20–22] (Scheme 1, route II), cyclization of β-amino alcohols,[23,24] β-amino halides,[23,24] β-azido alcohols[23–25] (Scheme 1, route III) and halo imines[26] (Scheme 1, route IV). However, only a few routes for the synthesis of *C*-nitroaziridines are available in the literature.[27–29]All these, basically involve the same chemistry, that is, the reaction of a nitroalkene or its derivatives with a nitrogen source, namely, ethyl [(4-nitrobenzenesulfonyl)oxy]carbamate (NsONHCOOEt), an azide or an amine (Scheme 1, routes V and VI).[27–29] Fioravanti et al. have recently reported an elegant synthesis of chiral nitroaziridines from optically active nitroalkenes and NsONHCOOEt.[29c]



Scheme 1. General synthetic routes to aziridines.

* Corresponding author. Tel.: +91 5322500652; fax: +91 5322460533.
E-mail address: ldsyadav@hotmail.com (Lal Dhar S. Yadav).

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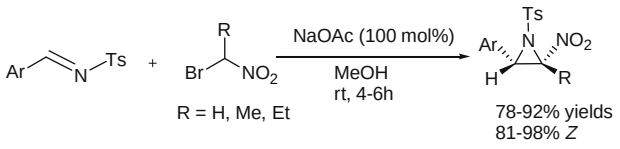
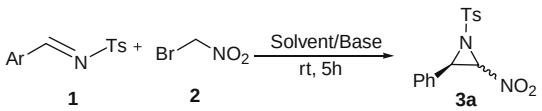
The literature records no report on the synthesis of 2-nitro-1-tosylaziridines. This gap and our continued efforts to develop new one-pot cyclization processes[30] attracted our attention to devise the first expeditious nitroaziridination of *N*-tosylaldimines with 1-bromonitroalkanes (Scheme 1, route VII). The reaction is catalyst-free, highly diastereoselective in favour of the *Z*-isomer and is performed in a one-pot procedure to afford excellent yields of hitherto unknown 2-nitro-1-tosylaziridines **3** under mild conditions (Scheme 2). Obviously, the present work is different from the work already reported[29] as it discloses the nitroaziridination of *N*-tosylaldimines with 1-bromonitroalkanes instead of nitroalkenes using NsONHCOOEt. The 2-nitro-1-tosylaziridines **3** thus obtained are promising synthetic intermediates since the nitro group offers a wide range of efficient methods for its transformation into various other functionalities.[31,32] Most importantly, the nitro group can be converted into a carbonyl group using the Nef reaction.[33] Moreover, the inherently strained aziridine ring would further enhance the synthetic potential of these nitro compounds via ring-opening reactions.

Initially, we set up a series of experiments to optimize the reaction conditions. Indeed, we used a very straightforward protocol and examined various solvent/base systems for the synthesis of representative compound **3a** (Table 1). Among all the systems tested, MeOH/NaOAc was found to be the best solvent/base system in terms of the yield as well as diastereoselectivity (Table 1, entry 1). It was noted that 100 mol % of the base was necessary to obtain the optimal yield. In order to investigate the substrate scope of the reaction, different *N*-tosylaldimines **1** were reacted with various 1-bromonitroalkanes **2** under the optimized reaction conditions. Both electron-donating and electron-withdrawing substituents are tolerated to afford the corresponding product **3** in consistently good yields and *Z*-diastereoselectivities (Table 2). The highest yield for the synthesis of **3** is 92% (Table 2, entry 5) and the highest *Z*-diastereoselectivity is 98% (Table 2, entry 4). The present optimized synthesis involves stirring of an equimolar mixture of *N*-tosylaldimine **1**, 1-bromonitroalkane **2** and NaOAc in MeOH at rt for 4–6 h to afford 2-nitro-1-tosylaziridines **3** in 78–92% yields with 81–98% diastereoselectivity in favour of the *Z*-isomer as determined by ^{1}H NMR spectroscopy (Table 2).[34]



Scheme 2. Diastereoselective synthesis of nitroaziridines **3**.

Table 1
Optimization of reaction conditions for the formation of **3a**



Entry	Solvent/base system	Yield[a] (%) Z-isomer	*Z*/*E*[b]
1	MeOH/NaOAc	83	92:8
2	MeOH/Et_3N	58	88.12
3	CH_2Cl_2/NaOAc	67	81:19
4	CH_2Cl_2/Et_3N	42	78:22
5	MeCN/NaOAc	69	84:16
6	MeCN/Et_3N	45	80:20

[a] Yield of isolated and purified *Z*-isomer of aziridine **3a**.
[b] As determined by ^{1}H NMR integration of *Z*- and *E*-isomers in the crude product.

Table 2
One-pot synthesis of nitroaziridines **3** from *N*-tosylaldimines **1** (Scheme 2)

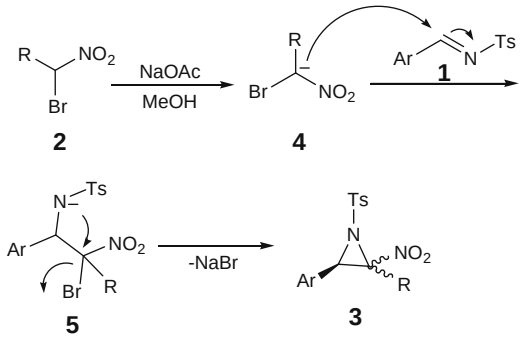
Entry	Aziridines **3**		Time[a] (h)	Yield[b,c] (%) *Z*-isomer	*Z*/*E*[d]
	Ar	R			
1	Ph	H	5	83	92:8
2	2-ClC_6H_4	H	5	85	95:5
3	4-ClC_6H_4	H	4	88	94:6
4	4-$MeOC_6H_4$	H	6	82	98:2
5	4-$O_2NC_6H_4$	H	4	92	96:4
6	Ph	Me	6	81	89:11
7	2-ClC_6H_4	Me	5	83	91:9
8	4-ClC_6H_4	Me	5	85	90:10
9	4-$MeOC_6H_4$	Me	6	80	96:4
10	4-$O_2NC_6H_4$	Me	4	89	93:7
11	Ph	Et	6	79	81:19
12	2-ClC_6H_4	Et	6	80	85:15
13	4-ClC_6H_4	Et	6	81	83:17
14	4-$MeOC_6H_4$	Et	5	78	92:8
15	4-$O_2NC_6H_4$	Et	5	87	89:11

[a] Time for completion of the reaction as indicated by TLC.
[b] Yield of isolated and purified products.
[c] All compounds gave C, H and N analyses within ±0.38% and satisfactory ^{1}H NMR, ^{13}C NMR and EIMS data.
[d] As determined by ^{1}H NMR integration of *Z*- and *E*-isomers in the crude product.

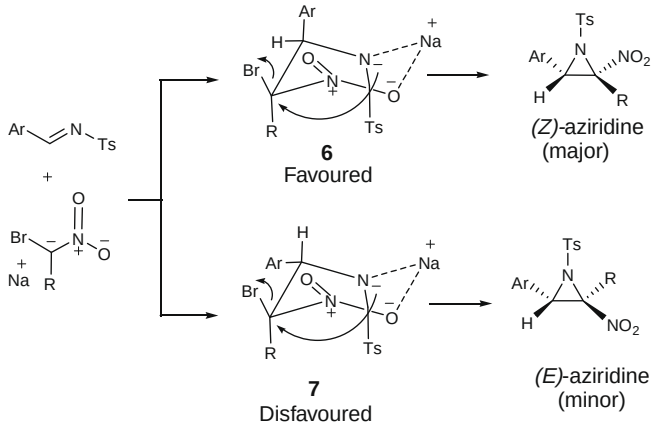
The formation of 2-nitroaziridines **3** plausibly involves nucleophilic addition of carbanion **4** generated from 1-bromonitroalkane **2** followed by intramolecular cyclization via nucleophilic substitution of tosylamide anion **5** to afford **3** with high *Z*-diastereoselectivity (Scheme 3). The observed diastereoselectivity in the formation of 2-nitroaziridines **3** may be explained by comparing the two metal-chelated chair-like intermediates **6** and **7** (Scheme 4). The intermediate **6** having the bulky groups Ar and Ts *trans* to each other is more stable (favoured) than **7** where these groups are cis. Thus, (*Z*)-aziridines are selectively formed through the intermediate **6** (Scheme 4).[35]

The *Z*-stereochemistry of aziridines **3** was assigned on the basis of higher *J*-values (9.6–9.8 Hz) of 2-H and 3-H than those for (*E*)-aziridines (6.7–6.8 Hz). This is in conformity with the earlier observations for aziridines reported in the literature.[36–38] Furthermore, strong NOEs, were observed between 2-H/3-H and 2-Me (or 2-Et)/3-H of aziridine **3**, which conclusively demonstrate that these protons are on the same face of the molecule and thus, prove their *Z*-stereochemistry (Fig. 1). On the other hand, in the case of *E*-isomer of **3** no appreciable NOEs were observed between 2-H/3-H and 2-Me (or 2-Et)/3-H, which indicate that these protons are on the opposite faces of the molecule.

In summary, we have developed a one-pot, general and efficient protocol for a convenient and diastereoselective synthesis of various chemically and pharmaceutically relevant 2-nitro-1-tosylaziridines from readily and widely available *N*-tosylaldimines



Scheme 3. A plausible mechanism for the formation of nitroaziridines **3**.



Scheme 4. A rationale for the *Z*-diastereoselectivity of nitroaziridination.

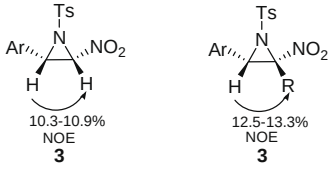


Figure 1. NOE experiment on aziridines **3**.

and 1-bromonitroalkanes. The synthesis is operationally simple, high yielding and performed under mild conditions.

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Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.tetlet.2009.07.054.

References and notes

1. Hu, X. E. *Tetrahedron* **2004**, *60*, 2701.
2. Stamm, H. *J. Prakt. Chem./Chem-Ztg* **1999**, *341*, 319.
3. (a) Zwanenburg, B.; ten Holte, P. *Top. Curr. Chem.* **2001**, *216*, 93; (b) Pearson, W. H.; Lian, B. W.; Bergmeier, S. C.. In *Comprehensive Heterocyclic Chemistry II*; Padwa, A., Ed.; Oxford: Pergamon, 1996; Vol. 1A, p 1.
4. (a) Watson, I. D. G.; Yu, L.; Yudin, A. K. *Acc. Chem. Res.* **2006**, *39*, 194; (b) Dalili, S.; Caiazzo, A.; Yudin, A. K. *J. Organomet. Chem.* **2004**, *689*, 3604; (c) Watson, I. D. G.; Yudin, A. K. *J. Org. Chem.* **2003**, *68*, 5160; (d) Caiazzo, A.; Dalili, S.; Yudin, A. K. *Synlett* **2003**, 2198; (e) Caiazzo, A.; Dalili, S.; Yudin, A. K. *Org. Lett.* **2002**, *4*, 2597.
5. (a) Muller, P.; Fruit, C. *Chem. Rev.* **2003**, *103*, 2905; (b) Sweeney, J. B. *Chem. Soc. Rev.* **2002**, *31*, 247; (c) Jacobsen, E. N.. In *Comprehensie Asymmetric Catalysis*; Jacobsen, E. N., Pfaltz, A., Yamamoto, H., Eds.; Springer Verlag: Berlin, 1999; Vol. 2, p 607; (d) Osborn, H. M.; Sweeney, J. *Tetrahedron: Asymmetry* **1997**, *8*, 1693; (e) Tanner, D. *Angew. Chem., Int. Ed. Engl.* **1994**, *33*, 599.
6. For leading reviews on the synthesis and application of aziridines, see: (a) Tanner, D. *Angew. Chem.* **1994**, *106*, 625; . *Angew. Chem., Int. Ed. Engl.* **1994**, *33*, 599; (b) Bois, J. D.; Tomooka, C. S.; Hong, J.; Carreira, E. M. *Acc. Chem. Res.* **1997**, *30*, 364; (c) Li, A.-H.; Dai, L.-X.; Aggarwal, V. K. *Chem. Rev.* **1997**, *97*, 2341; (d) Ibuka, T. *Chem. Soc. Rev.* **1998**, *27*, 145; (e) McCoull, W.; Davis, F. A. *Synthesis* **2000**, 1347; (f) Redlich, M. D.; Mayer, M. F.; Hossain, M. M. *Aldrichim. Acta* **2003**, *36*, 3; (g) Tang, Y.; Ye, S.; Sun, X.-L. *Synlett* **2005**, 2720; (h) Katsuki, T. *Chem. Lett.* **2005**, *34*, 1304.
7. Hodgkinson, T. J.; Shipman, M. *Tetrahedron* **2001**, *57*, 4467.
8. Coleman, R. S.; Kong, J. S.; Richardson, T. E. *J. Am. Chem. Soc.* **1999**, *121*, 9088.
9. Coleman, R. S.; Li, J.; Navarro, A. *Angew. Chem., Int. Ed.* **2001**, *40*, 1736.
10. Kasai, M.; Kono, M. *Synlett* **1992**, 778.
11. Remers, W. A. In *The Chemistry of Antitumor Antibiotics*; Wiley Interscience: New York, 1979; Vol. 1.
12. Katoh, T.; Itoh, E.; Yoshino, T.; Terashima, S. *Tetrahedron* **1997**, *53*, 10229.
13. Sweeney, J. B. *Chem. Soc. Rev.* **2002**, *31*, 247.
14. Tanner, M. E.; Miao, S. *Tetrahedron Lett.* **1994**, *35*, 4073.
15. Gerhart, F.; Higgins, W.; Tardif, C.; Ducep, J. B. *J. Med. Chem.* **1990**, *33*, 2157.
16. Skibo, E. B.; Islam, I.; Heileman, M. J.; Schulz, W. G. *J. Med. Chem.* **1994**, *37*, 78.
17. Muller, P.; Baud, C.; Jacquier, Y. *Tetrahedron* **1996**, *52*, 1543.
18. Evans, D. A.; Faul, M. M.; Bilodeau, M. T. *J. Am. Chem. Soc.* **1994**, *116*, 2742.
19. Atkinson, R. S. *Tetrahedron* **1999**, *55*, 1519.
20. Hansen, K. B.; Finney, N. S.; Jacobsen, E. N. *Angew. Chem., Int. Ed.* **1995**, *34*, 676.
21. Juhl, K.; Hazell, R. G.; Jørgensen, K. A. *J. Chem. Soc., Perkin Trans. 1* **1999**, 2293.
22. Pellicciari, R.; Amori, L.; Kuznetsova, N.; Zlotsky, S.; Gioiello, A. *Tetrahedron Lett.* **2007**, *48*, 4911.
23. Kemp, J. E. G. In *Comprehensive Organic Synthesis*; Trost, B. M., Fleming, I., Eds.; Pergamon: Oxford, 1991; Vol. 7, p 467.
24. Padwa, A.; Murphree, S. S. In *Progress in Heterocyclic Chemistry*; Gribble, G. W., Gilchrist, T. L., Eds.; Pergamon Elsevier Science: Oxford, 2000; Vol. 12, p 57. Chapter 4.1.
25. Osborn, H. M. I.; Sweeney, J. *Tetrahedron: Asymmetry* **1997**, *8*, 1693.
26. (a) De Kimpe, N.; Verhé, R.; De Buyck, L.; Schamp, N. *Synth. Commun.* **1975**, *5*, 269; (b) De Kimpe, N.; Verhé, R.; De Buyck, L.; Schamp, N. *Recl. Trav. Chim. Pays-Bas* **1977**, *96*, 242; (c) De Kimpe, N.; Champ, N.; Verhé, R. *Synth. Commun.* **1975**, *5*, 403; (d) De Kimpe, N.; Moens, L. *Tetrahedron* **1990**, *46*, 2965; (e) De Kimpe, N.; Moens, L.; Verhé, R.; De Buyck, L.; Schamp, N. *J. Chem. Soc., Chem. Commun.* **1982**, 19; (f) De Kimpe, N.; Sulmon, P.; Verhé, R.; De Buyck, L.; Schamp, N. *J. Org. Chem.* **1983**, *48*, 4320; (g) De Kimpe, N.; Verhé, R.; De Buyck, L.; Schamp, N. *J. Org. Chem.* **1980**, *45*, 5319.
27. (a) Person, H.; Foucaud, A. *Sci. Chim.* **1975**, *281*, 325; (b) Person, H.; Foucaud, A. *Bull. Soc. Chim. Fr.* **1976**, *7-8*, 1119; (c) Person, H.; Tonnard, F.; Foucaud, A.; Fayat, C. *Tetrahedron Lett.* **1973**, *14*, 2495.
28. Edasery, J. P.; Cromwell, N. H. *J. Hetrocycl. Chem.* **1979**, *16*, 831.
29. (a) Fivoravanti, S.; Pellacani, L.; Stabile, S.; Tardella, P. A.; Ballini, R. *Tetrahedron Lett.* **1997**, *38*, 3309; (b) Fioravanti, S.; Pellacani, L.; Stabile, S.; Tardella, P. A.; Ballini, R. *Tetrahedron* **1998**, *54*, 6169; (c) Fivoravanti, S.; Marchetti, F.; Pellacani, L.; Ranieri, L.; Tardella, P. A. *Tetrahedron: Asymmetry* **2008**, *19*, 231.
30. (a) Yadav, L. D. S.; Kapoor, R.; Garima, *Synlett* **2009**, 1055; (b) Yadav, L. D. S.; Rai, V. K.; Yadav, B. S. *Tetrahedron* **2009**, *65*, 1306; (c) Yadav, L. D. S.; Kapoor, R. *Synlett* **2008**, 2348; (d) Yadav, L. D. S.; Kapoor, R. *Tetrahedron Lett.* **2008**, *49*, 4840; (e) Yadav, L. D. S.; Rai, A.; Rai, V. K.; Awasthi, C. *Tetrahedron* **2008**, *64*, 1420; (f) Yadav, L. D. S.; Awasthi, C.; Rai, V. K.; Rai, A. *Tetrahedron Lett.* **2007**, *48*, 4899; (g) Yadav, L. D. S.; Yadav, S.; Rai, V. K. *Green Chem.* **2006**, *8*, 455; (h) Yadav, L. D. S.; Kapoor, R. *J. Org. Chem.* **2004**, *69*, 8118.
31. Ono, N. *The Nitro Group in Organic Synthesis*; Wiley-VCH: New York, 2001.
32. (a) Ballini, R.; Rosini, G. *Synthesis* **1988**, 833; (b) Rosini, G.; Ballini, R.; Petrini, M.; Marotta, E.; Righi, P. *Org. Prep. Proced. Int.* **1990**, *22*, 707; (c) Ballini, R.; Marziali, P.; Mozzicafreddo, A. *J. Org. Chem.* **1996**, *61*, 3209; (d) Ballini, R.; Bosica, G. *Tetrahedron Lett.* **1996**, *37*, 8027; (e) Ballini, R.; Bosica, G. *J. Org. Chem.* **1997**, *62*, 425; (f) Ballini, R.; Petrini, M. *Tetrahedron* **2004**, *60*, 1017; (g) Amantini, D.; Fringuelli, F.; Piermatti, O.; Pizzo, F.; Vaccaro, C. *J. Org. Chem.* **2003**, *68*, 9263; (h) Marotta, E.; Righi, P.; Rosini, G. *Tetrahedron Lett.* **1998**, *39*, 1041; (i) Areces, P.; Gil, M. V.; Higes, F. J.; Romàn, E.; Serrano, J. A. *Tetrahedron Lett.* **1998**, *39*, 8557.
33. Pinnick, H. W. *Org. React.* **1990**, *38*, 655.
34. *General procedure for the synthesis of 3-aryl-2-nitro-1- tosylaziridines* **3**: A mixture of sodium acetate (1 mmol), 1-bromonitroalkane **2** (1 mmol) and *N*-tosylaldimine **1** (1 mmol) in methanol (5 mL) was stirred at rt for 4–6 h (Table 2). After completion of the reaction (monitored by TLC), water (5 mL) was added and the product was extracted with diethyl ether (3 × 10 mL). The combined extract was dried over $MgSO_4$, filtered, concentrated under reduced pressure, and the crude product thus obtained was purified by silica gel chromatography using ethyl acetate-*n*-hexane (2:8) as eluent to afford an analytically pure sample of **3**. Physical data of representative compounds: Compound **3**. (Table 2, entry 3, Ar = 4-ClC_6H_4, R = H), *Z*-isomer: Yellowish solid, yield 88%, mp 148–150 °C. IR (KBr) ν_{max} 3043, 2831, 1601, 1568, 1511, 1465, 1330, 1164, 857, 835 cm^{-1}. ^1H NMR (400 MHz; $CDCl_3$/TMS) δ: 2.35 (s, 3H, $TsCH_3$), 4.99 (d, 1H, *J* = 9.8 Hz, 3-H), 6.10 (d, 1H, *J* = 9.8 Hz, 2-H), 7.00–7.23 (m, 4H, 4-ClC_6H_4), 7.34 (d, 2H, *J* = 8.1 Hz, Ts), 7.81 (d, 2H, *J* = 8.1 Hz, Ts) ^{13}C NMR (100 MHz; $CDCl_3$/TMS) δ: 24.0, 48.4, 76.7, 127.2, 128.1, 129.0, 130.0, 132.2, 134.3, 136.8, 144.7. EIMS (*m/z*): 352 (M^+). Anal. Calcd for $C_{15}H_{13}ClN_2O_4S$: C, 51.07; H, 3.71; N, 7.94. Found: C, 50.74; H, 3.47; N, 8.30. Compound **3** (Table 2, entry 8, Ar = 4-ClC_6H_4, R = Me) *Z*-isomer: Yellowish solid, yield 85%, mp 161–163 °C. IR (KBr) ν_{max} 3040, 2825, 1605, 1560, 1515, 1460, 1335, 1160, 860, 840 cm^{-1}. ^1H NMR (400 MHz; $CDCl_3$/TMS) δ: 1.64 (s, 3H, CH_3), 2.35 (s, 3H, $TsCH_3$), 4.98 (s, 1H, 3-H), 7.00–7.22 (m, 4H, 4-ClC_6H_4), 7.33 (d, 2H, *J* = 8.1 Hz, Ts), 7.80 (d, 2H, *J* = 8.1 Hz, Ts) ^{13}C NMR (100 MHz; $CDCl_3$/TMS) δ: 19.0, 24.2, 49.0, 80.0, 127.0, 128.2, 129.1, 130.1, 132.0, 134.2, 136.9, 144.6. EIMS (*m/z*): 366 (M^+). Anal. Calcd for $C_{16}H_{15}ClN_2O_4S$: C, 52.39; H, 4.12; N, 7.64. Found: C, 52.77; H, 4.33; N, 7.36. Compound **3** (Table 2, entry 13, Ar = 4-ClC_6H_4, R = Et) *Z*-isomer: Yellowish solid, yield 81%, mp 172–174 °C. IR (KBr) ν_{max} 3045, 2833, 1607, 1555, 1520, 1463, 1333, 1162, 810, 860 cm^{-1}. ^1H NMR (400 MHz; $CDCl_3$/TMS) δ: 0.92 (t, 3H, *J* = 7.8 Hz, CH_3), 1.78 (q, 2H, *J* = 7.8 Hz, CH_2), 2.35 (s, 3H, $TsCH_3$), 4.97 (s, 1H, 3-H), 7.00–7.21 (m, 4H, 4-ClC_6H_4), 7.32 (d, 2H, *J* = 8.1 Hz, Ts), 7.79 (d, 2H, *J* = 8.1 Hz, Ts) ^{13}C NMR (100 MHz; $CDCl_3$/TMS) δ: 10.8, 24.6, 33.1 48.9, 82.0, 127.1, 128.0, 129.0, 130.2, 132.1, 134.0, 136.7, 144.7. EIMS

(*m*/*z*): 380 (M^+). Anal. Calcd for $C_{17}H_{17}ClN_2O_4S$: C, 53.61; H, 4.50; N, 7.36. Found: C, 53.84; H, 4.24; N, 7.71.
35. We thank the reviewer for his suggestion.
36. Nadir, U. K.; Arora, A. *Synth. Commun.* **1996**, *26*, 2355.
37. Aggarwal, V. K.; Alonso, E.; Ferrara, M.; Spey, E. S. *J. Org. Chem.* **2002**, *67*, 2335.
38. Aggarwal, V. K.; Ferrara, M. *Org. Lett.* **2000**, *2*, 4107.