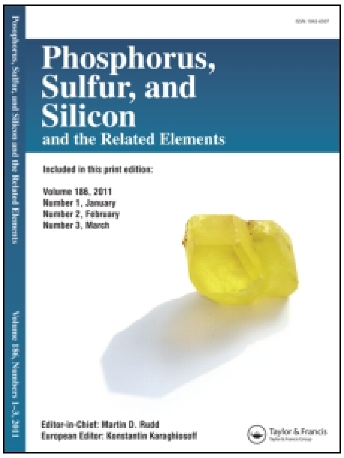


Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

N,N',N,N'-TETRABROMO-BENZENE-1,3-DISULFONYLAMIDE AS A NOVEL REAGENT FOR OXIDATIVE AROMATIZATION OF 1,3,5-TRISUBSTITUTED PYRAZOLINES UNDER HETEROGENEOUS AND SOLVENT-FREE CONDITIONS

Ramin Ghorbani-Vaghei[a]; Davood Azarifar[a]; Ardeshir Khazaei[a]; Behrooz Maleki[a]
[a] Department of Chemistry, Faculty of Science, Bu-Ali Sina University, Hamadan, Iran

To cite this Article Ghorbani-Vaghei, Ramin , Azarifar, Davood , Khazaei, Ardeshir and Maleki, Behrooz(2004) '*N,N',N,N'*-TETRABROMO-BENZENE-1,3-DISULFONYLAMIDE AS A NOVEL REAGENT FOR OXIDATIVE AROMATIZATION OF 1,3,5-TRISUBSTITUTED PYRAZOLINES UNDER HETEROGENEOUS AND SOLVENT-FREE CONDITIONS', Phosphorus, Sulfur, and Silicon and the Related Elements, 179: 9, 1877 — 1881

To link to this Article: DOI: 10.1080/10426500490466797

URL: http://dx.doi.org/10.1080/10426500490466797

Phosphorus, Sulfur, and Silicon, 179:1877–1881, 2004
Copyright © Taylor & Francis Inc.
ISSN: 1042-6507 print / 1563-5325 online
DOI: 10.1080/10426500490466797

Taylor & Francis
Taylor & Francis Group

N,N′,N,N′-TETRABROMO-BENZENE-1,3-DISULFONYLAMIDE AS A NOVEL REAGENT FOR OXIDATIVE AROMATIZATION OF 1,3,5-TRISUBSTITUTED PYRAZOLINES UNDER HETEROGENEOUS AND SOLVENT-FREE CONDITIONS

Ramin Ghorbani-Vaghei, Davood Azarifar, Ardeshir Khazaei,
and Behrooz Maleki
Department of Chemistry, Faculty of Science, Bu-Ali Sina
University, Hamadan, Iran

(Received December 30, 2003; accepted February 5, 2004)

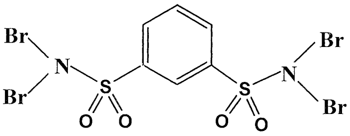
1,3,5-Trisubstituted pyrazolines were converted to the corresponding pyrazoles in good yields under heterogeneous and solvent-free conditions by N,N′,N,N′*-tetrabromo-benzene-1,3-disulfonylamide [TBBDA] at ambient temperature.*

Keywords: Aromatization; oxidative; pyrazolines; TBBDA

INTRODUCTION

Five-membered heterocyclic compounds are important constitutents that often exist in biologically active natural products and synthetic compounds of medicinal interest.[1] Among them, 1,3,5-trisubstituted pyrazolines can be easily prepared from phenylhydrazine and chalcone derivatives.[2] Therefore, oxidative aromatization of pyrazolines with oxidizing reagents should provide an efficient method for the preparation of pyrazole derivatives. For this oxidative conversion of pyrazolines, a limited number of reports exist in the literature, which include $Zr(NO_3)$,[3] Pd/C,[4] Co (II) and oxygen,[5] iodobenzene diacetate,[6] lead tetraacetate,[7] MnO_2,[8] potassium permanganate,[9] and NBS.[10] They either require too severe of a reaction condition or their use is accompanied by products of decompositions and ring scission.

Address correspondence to Ramin Ghorbani-Vaghei, Department of Chemistry, Faculty of Science, Bu-Ali Sina University, Hamadan, Iran. E-mail: ghorbani@basu.ac.ir



1 TBBDA

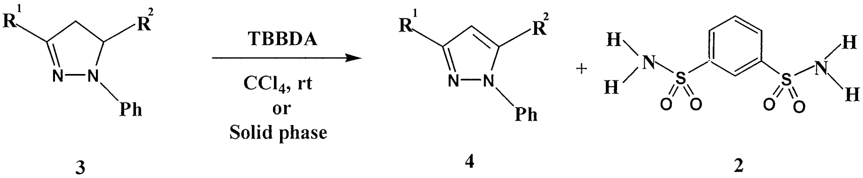
FIGURE 1

RESULTS AND DISCUSSION

We now wish to report a mild general route for the oxidative dehydrogenation of 1,3,5-trisubstituted pyrazolines to the corresponding pyrazoles using the new reagent *N,N,′N,N,′*-tetrabromo-benzene-1,3-disulfonylamide [TBBDA] (Figure 1), which is relatively easy to make, under heterogeneous and solvent-free conditions. The reaction proceeds smoothly and in high yield under fairly mild conditions compared to the methods reported previously.

The generality of the method is evident from the fact that a wide variety of substituted pyrazolines underwent smooth oxidation in good yields.

The reaction of 1,3,5-trisubstituted pyrazolines with TBBDA in carbon tetrachloride and solid phase at room temperature afforded pyrazoles without side products (Scheme 1).



SCHEME 1

The results of the conversion of various 1,3,5-trisubstituted pyrazolines to their corresponding pyrazoles under heterogeneous and solvent-free conditions are presented in Table I.

Solvent-free organic synthesis seems to be a highly useful technique, especially for industry, and it has many advantages: reduced pollution, low costs, and simplicity in process and handling (these factors are especially important in industry).[3,11,12]

TABLE I Aromatization of 1,3,5-Trisubstituted Pyrazolines with TBBDA in Solution (I) and Solvent-Free (II) Conditions at Room Temperature

				Reagent/ Product			
Substrate	Product[a]	R^1	R^2	I	II	Time (h) I (II)	Yield (%) I (II)
3a	4a	2-Naphtyl	2-$CH_3C_6H_4$	1	2.75	0.3 (0.9)	94 (82)
3b	4b	2-Naphtyl	Ph	1	2.75	0.3 (1)	90 (80)
3c	4c	Ph	Ph	1.25	2.75	0.3 (1)	92 (78)
3d	4d	4-$CH_3C_6H_4$	3-$CH_3C_6H_4$	2.25	3.75	0.6 (1.3)	90 (78)
3e	4e	3-$CH_3C_6H_4$	2-ClC_6H_4	2	3.5	0.3 (0.8)	78 (68)
3f	4f	4-$OCH_3C_6H_4$	3-$CH_3C_6H_4$	2	3	0.5 (1.25)	90 (76)
3g	4g	4-$OCH_3C_6H_4$	2-$CH_3C_6H_4$	2.25	3.25	0.5 (1)	86 (70)
3h	4h	4-$OCH_3C_6H_4$	Ph	1.75	3	0.3 (1)	90 (75)
3i	4i	4-$OCH_3C_6H_4$	4-ClC_6H_4	2	3.75	0.6 (1.25)	75 (62)
3j	4j	3-$CH_3C_6H_4$	4-ClC_6H_4	2	3.5	0.5 (1.25)	92 (80)
3k	4k	2-Naphthyl	3-$CH_3C_6H_4$	2	3	0.4 (1)	88 (73)
3l	4l	2-Naphthyl	4-ClC_6H_4	2.5	4	0.3 (1.3)	80 (70)
3m	4m	2-Naphthyl	2-ClC_6H_4	2.25	3.5	0.3 (0.9)	72 (62)
3n	4n	3-$CH_3C_6H_4$	4-$N(CH_3)_2C_6H_4$	2.25	3.75	0.4 (0.9)	90 (72)
3o	4o	2-$CH_3C_6H_4$	4-$N(CH_3)_2C_6H_4$	2	3.75	0.3 (1)	85 (66)
3p	4p	4-$OCH_3C_6H_4$	2-ClC_6H_4	2	3	0.3 (1.1)	90 (79)

[a] Products were characterized by their physical properties, comparison with authentic samples, and by spectroscopic methods.

The advantages of TBBDA are as follows:

1. The preparation of TBBDA is easy.
2. TBBDA is stable in atmospheric conditions for three months.
3. After completion of the reaction and evaporation of solvent, the sulphonamide is recovered and can be reused many times without decreasing the yield.

Since TBBDA contains four bromine atoms that are attached to nitrogen atoms, it is very possible that this reagent releases Br^+, which can act as an electrophilic species,[13] in situ.

CONCLUSIONS

From the results obtained, we find that the described procedure and the reaction conditions are simple. The new reagent (TBBDA) is stable, and the recovered reagent can be reused.

Infrared (IR) and nuclear magnetic resonance (NMR) spectra were recorded using a Shimadzu 435-U-04 spectrophotometer (KBr pellets) and a 90 MHz Jeol FT-NMR spectrometer, respectively.

Procedure for Preparation of Benzene-1,3-disulfonylamide

To benzene-1,3-disulfonyl acid sodium salt (0.016 mol) was added PCl_5 (0.0165 mol) as a chlorination agent. For starting the reaction, the vessel should be heated (40–50°C), then reaction completes spontaneously. After complete conversion (2 h), crushed ice (100 g) was added and the product was separated from inorganic materials by chloroform extraction.

Then NH_3 (1) (400 ml) was added to the solution and the reaction mixture was stirred. After complete addition, removal of the solvent under reduced pressure gave the crude product. The pure product (90%, m.p. 228–230°C) was obtained by crystallization with ethanol. IR spectrum (KBr pellets): 3320, 3090, 1600, 1320, 1130 cm^{-1}. ^1H NMR (acetone-d^6): δ 6.7 (s, 4H), 7.7 (t, 1H), 8.1 (d, 2H), 8.3 (s, 1H). ^{13}C NMR: 124.2, 130.6, 129.8, 124.2.

Procedure for Preparation of *N,N′,N,N′*-Tetrabromo-benzene-1,3-disulfonylamide [TBBDA]

N,N′,N,N′-Tetrabromo-benzene-1,3-disulfonylamide (0.003 mol) was dissolved in a slight molar excess of chilled sodium hydroxide solution (3 M) at room temperature and the solution transferred to a beaker. Then bromine (0.0584 mol) was added to the solution with vigorous stirring. Immediately a precipitate was formed. The product was collected on a Buchner funnel, and it was washed with 30 ml of distilled cold water and then dried in a vacuum dessicator at room temperature for 6 h. The yield of pure TBBDA, m.p. 267–270d°C, was 90%. The reagent was identified by NMR and IR spectroscopies. IR spectrum (KBr pellets): 3070, 1620, 1310, 1130 cm^{-1}. ^1H NMR (acetone-d^6): δ 7.9 (t, 1H), 8 (d, 2H), 8.3 (s, 1H). ^{13}C NMR spectrum (acetone): δ 123.4, 128.7, 127.9, 122.3.

General Procedure for Oxidation of 1,3,5,-Substituted Pyrazolines with TBBDA

To a solution of 1,3,5-trisubstituted pyrazoline **3** (2 mmol) in CCl_4 (10 ml) was added TBBDA (molar ratio given in Table I). The reaction mixture was stirred at room temperature for the time given in Table I. After complete conversion as indicated by TLC, K_2CO_3 (0.5 g) was added and the mixture stirred for 0.5 h, and the insoluble sulphonamide **2** was removed by filtration and washed with cold CCl_4 (5 ml). Removal of the solvent under reduced pressure gave the crude product. The pure product **4** was obtained by recrystallization with methanol/H_2O (10:1).

General Procedure for Oxidation of 1,3,5-Substituted Pyrazolines with TBBDA, Solvent Free

To 1,3,5-trisubstituted pyrazoline **3** (2 mmol) was added TBBDA (molar ratio given in Table I). The reaction mixture was stirred at room temperature for the time given in Table I. After complete conversion as indicated by TLC [*n*-hexane/acetone (10/1)], carbon tetrachloride and K_2CO_3 (0.5 g) were added to the reaction mixture, and then it was stirred for 0.5 h. The insoluble sulphonamide **2** was removed by filtration and washed with cold CCl_4 (5 ml). Removal of the solvent under reduced pressure gave the crude product. The pure product 4 was obtained with flash chromatography on silica gel [eluent: *n*-hexane/acetone (10:1)].

REFERENCES

[1] a) T. L. Gilchrist, *Heterocyclic Chemistry*, 3rd ed. (Addison-Wesley Longman, Ltd., Essex, England, 1998); b) D. Lednicer, *Strategies for Organic Drugs Synthesis and Design* (Wiley & Sons, New York, 1998); Chaps. 8 and 9.

[2] a) D. Azarifar and M. Shaebanzadeh, *Molecules*, **7,** 885 (2002); b) D. Azarifar and H. Ghasemnejad, *Molecules*, **8,** 642 (2003).

[3] G. Sabitha, G. S. K. K. Reddy, C. S. Reddy, N. Fatima, and J. S. Yadav, *Synthesis*, 1267 (2003).

[4] N. Nakamichi, Y. Kawashita, and M. Hayashi, *Org. Lett.*, **4,** 3955 (2002).

[5] J. N. Shah and C. K. Shah, *J. Org. Chem.*, **43,** 1266 (1978).

[6] S. P. Singh, D. Kumar, O. Prakash, and R. P. Kapoor, *Synth. Commun.*, **27,** 2683 (1997).

[7] W. A. F. Gladstone and R. O. C. Norman, *J. Chem. Soc., Chem. Commun.*, **14,** 1536 (1966).

[8] I. Bhatnagar and M. V. George, *Tetrahedron*, **24,** 1293 (1968).

[9] L. I. Smith and K. L. Howard, *J. Am. Chem. Soc.*, **65,** 159 (1943).

[10] W. Ried and R. Lantzsch, *Chem. Ber.*, **102,** 378 (1969).

[11] R. S. Varma, *Green Chem.*, **1,** 43 (1999).

[12] K. Tanaka and F. Toda, *Chem. Rev.*, **100,** 1025 (2000).

[13] R. Ghorbani-Vaghei and A. Khazaei, *Tetrahedron Lett.*, **44,** 7525 (2003).