Facile and Chemoselective Microwave-Assisted Cleavage of Oximes to Their Corresponding Carbonyl Compounds Using *N*,*N*′-Dibromo- *N*,*N*′-1,3-propylene-bis[(4-methylphenyl)sulfonamide] as a Deoximating Reagent

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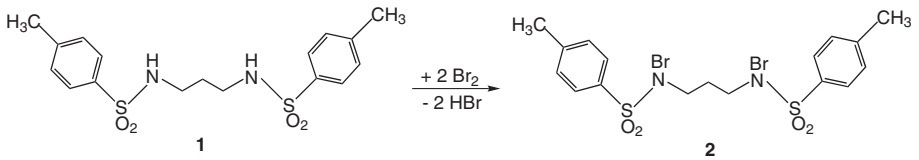
Abstract: Aldoximes and ketoximes are converted to the parent carbonyl compounds in good yields when treated with *N*,*N*′-dibromo-*N*,*N*′-1,3-propylene-bis[(4-methylphenyl)sulfonamide] (**2**) under microwave irradiation. The simple workup minimizes the loss of product and oximes have been selectively oxidized in the presence of alcohols and alkenes.

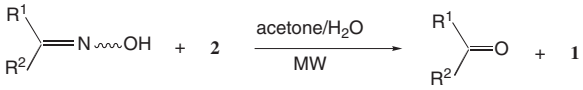
Key words: aldoximes, carbonyl compounds, ketoximes, microwave irradiation, selective

Oximes are easily obtained from carbonyl compounds and have great potential as intermediates in organic synthesis.[1] They are also useful protecting groups in multistep organic syntheses[2] and have found extensive application in the isolation of carbonyl compounds.[3] Their synthesis from non-carbonyl compounds offers an alternative route to aldehydes and ketones.[4,5] A good number of methods based on hydrolytic,[6] reductive,[7] and oxidative[8] reactions have been developed for their deoximation. In spite of the many reagents available, there is still scope for newer reagents as the existing oxidative methods suffer from one or the other disadvantages such as long reaction times,[9] difficulties in isolation of products,[5] and formation of over oxidation products leading to low yields.

Advantages such as cleaner reactions, very short reaction times, and ease in workup have kindled a special interest in microwave chemistry.[10] We now report a new oxidative method for the selective cleavage of oximes to their carbonyl compounds under microwave irradiation using *N*,*N*′-dibromo-*N*,*N*′-1,3-propylene-bis[(4-methylphenyl)sulfonamide] (**2**) as an effective oxidizing agent that overcomes the disadvantages associated with oxidative methods developed so far. The title reagent was prepared from *N*,*N*′-1,3-propylene-bis[(4-methylphenyl)sulfonamide] (**1**) (Scheme 1).[11]



Scheme 1



Scheme 2

Microwave irradiation of a solution of oximes in aqueous acetone in the presence of title reagent **2** gave the corresponding carbonyl compounds in good yields (Scheme 2).

The results of the conversions of various oximes to their corresponding carbonyl compounds are presented in Table 1.

A sterically hindered ketone oxime (entry 13) was also oxidatively cleaved to the corresponding ketone in good yield. The aldoximes were converted to the corresponding aldehydes and no carboxylic acid was formed due to overoxidation of the regenerated aldehyde (entries 3, 4, 7, 10 and 15). This procedure is also useful for the chemoselective oxidative deoximation of oximes in the presence of alcohols or for oximes that contain an OH functional group (entry 12). Thus, when equimolar mixtures of benzophenone oxime and benzyl alcohol in acetone and water were allowed to react with title reagent **2** under microwave irradiation, the ketoxime underwent oxidative deoximation chemoselectively, giving (91%) benzophenone, whereas the benzyl alcohol was recovered unchanged (Scheme 3).

An unsaturated oxime (entry 15) was cleaved to the corresponding unsaturated aldehyde without affecting the double bond. We also observed the competitive oxidation of oximes in the presence of an alkene. In a control experiment, when equimolar mixtures of ethyl methyl ketone oxime and cyclohexene in acetone and water were allowed to react with the title reagent **2**, under microwave irradiation, the ketone oxime underwent chemoselectively

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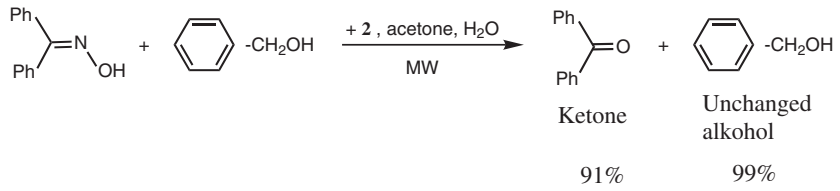
Table 1 Deoximation with **2** under MW Irradiation

Entry	Substrate	Product	Time (min)	Yield (%)[a,b]
1	cyclohexanone oxime	cyclohexanone	1	98
2	acetophenone oxime	acetophenone	1	94
3	benzaldehyde oxime	benzaldehyde	1	93
4	4-chlorobenzaldehyde oxime	4-chlorobenzaldehyde	1	92
5	benzophenone oxime	benzophenone	1.1	92
6	4-methylacetophenone oxime	4-methylacetophenone	1.1	92
7	isobutyraldehyde oxime	isobutyraldehyde	1.2	92[c]
8	isobutyl methyl ketone oxime	isobutyl methyl ketone	1.5	91
9	diisopropyl ketone oxime	diisopropyl ketone	1.6	91
10	2-chlorobenzaldehyde oxime	2-chlorobenzaldehyde	2	90
11	ethyl methyl ketone oxime	ethyl methyl ketone	2	90
12	benzoin oxime	benzoin	2	85
13	camphor oxime	camphor	2.5	84
14	cyclopentanone oxime	cyclopentanone	2.5	84
15	cinnamaldehyde oxime	cinnamaldehyde	2	83

[a] Products were characterized by their physical constants, comparison with authentic samples and melting points of 2,4-dinitrophenylhydrazone derivatives and by their IR and ^{1}H NMR spectra.
[b] Isolated yields.
[c] CH_2Cl_2/H_2O was used as reaction solvent.

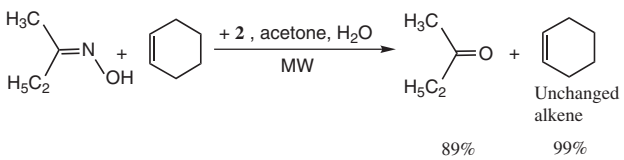


Scheme 3 Selective deoximation in the presence of benzyl alcohol.

oxidative deoximation giving 89% ethyl methyl ketone, whereas the cyclohexene was recovered unchanged (Scheme 4).

At the end of the reaction, *N,N′*-dibromo-*N,N′*-1,3-propylene-bis[(4-methylphenyl)sulfonamide] (**2**) was converted to the *N,N′*-1,3-propylene-bis[(4-methyl-phenyl)-sulfonamide] (**1**), which can be isolated, brominated, and reused as deoximating reagent.

In conclusion, the striking features of our method are: very short reaction times; no formation of over oxidation products, due to the high chemoselectivity and mild nature of title reagent **2**; easy workup procedure; and high yields. The OH functional group in the oxime structure does not get oxidized to a carbonyl functional group, and the debrominated product **1** can be converted to **2** and reused several times.



Scheme 4 Chemoselective deoximation in the presence of cyclohexene.

IR and ^{1}H NMR spectra were recorded using a Shimadzu 435-U-04 spectrophotometer (KBr pellets) and a 90 MHz Jeol FT-NMR spectrometer, respectively. ^{1}H NMR chemical shifts were measured relative to TMS (int; 1H).

***N,N′*-1,3-Propylene-bis[(4-methylphenyl)sulfonamide] (1)**
4-Methylbenzenesulfonyl chloride (20.0 g, 105 mmol) was placed in a beaker and heated on a water bath (80 °C) until it became a liquid. 1,2-Diaminoethane (4.37 mL, 53 mmol) was then added dropwise and the mixture was stirred with a glass rod. The mixture was heated (80 °C) and stirred for 30 min. The mixture was cooled and distilled H_2O (100 mL) was added. The product was collected by

suction on a Büchner funnel, and washed with a little cold H_2O and recrystallized from EtOH; yield: 19.1g (95%); mp 139–140 °C.

IR (KBr): 3272, 2934, 1596, 1464, 1325, 1158, 1089, 816 cm^{-1}.

^1H NMR (acetone-d_6/TMS): δ = 1.63 (m, 2 H), 2.36 (s, 6 H), 2.88 (t, 4 H), 6.32 (br, 2 H), 7.37–7.62 (m, 8 H).

Anal. Calcd for $C_{17}H_{22}N_2O_4S_2$: C, 53.38; H, 5.80; N, 7.32. Found: C, 53.50; H, 6.00; N, 7.45%.

N,N′-Dibromo-N,N′-1,3-propylene-bis[(4-methylphenyl)sulfonamide] (2)

The sulfonamide **1** (10.0 g, 26 mmol) was dissolved in a slight molar excess of chilled aq NaOH solution (ca. 3 M) at r.t. and the solution was transferred to a beaker. A solution of Br_2 (2.68 mL, 52 mmol) in CCl_4 (6 mL) was added to the solution with vigorous stirring. Immediately a yellow precipitate began to form. The yellow precipitate was collected by suction on a Büchner funnel, washed with cold distilled H_2O (30 mL), and then dried in a vacuum desiccator at r.t. for 6 h; yield: 11.7g (83%). The product was stable at r.t. and not sensitive to air.

IR (KBr): 2922, 1592, 1436, 1350, 1161, 812 cm^{-1}.

^1H NMR (acetone-d_6/TMS): δ = 1.62 (m, 2 H), 2.35 (s, 6 H), 2.87 (t, 4 H), 7.36–7.63 (m, 8 H).

Anal. Calcd for $C_{17}H_{20}Br_2N_2O_4S_2$: C, 37.80; H, 3.73; N, 5.18. Found: C, 37.94; H, 3.90; N, 5.30.

Deoximation of Oximes; General Procedure

A mixture of the oxime (3 mmol) and **2** (973 mg, 1.8 mmol), in acetone (10 mL) and H_2O (1 mL) was introduced in a flask and refluxed under microwave irradiation in a microwave oven at a power output of 200 W for the appropriate time as indicated in Table 1. After completion of the reaction (TLC), the solvent was removed under reduced pressure, and Et_2O (20 mL) was added to the mixture, and stirred for 10 min. Then the sulfonamide **1**, was removed by filtration and the product was purified by column chromatography (hexane–Et_2O) (Table 1).

Products (aldehydes and ketones) were characterized by their physical constants, by comparison with authentic samples, and the melting points of 2,4-dinitrophenylhydrazone derivatives and by their IR and ^1H NMR spectra.

References

(1) Sandler, S. R.; Karo, W. *Organic Functional Group Preparations*, 2nd ed., Vol. 3; Academic Press: San Diego, **1989**, 431–476.
(2) Green T. W., Wuts P. G. M.; *Protective Groups in Organic Synthesis;* Wiley: New York, 1991; 2nd ed., 214.
(3) Donaruma, L. G.; Heldt, W. Z. *Org. React.* **1960**, *11*, 1.
(4) Olah, G. A.; Liao, Q.; Lee, S. C.; Surya Perakash, G. K. *Synlett* **1993**, 427.
(5) Drabowicz, J. *Synthesis* **1980**, 125.
(6) Donaldson, R. E.; Saddler, J. C.; Boyrn, S.; Mckenzie, A. T.; Fuchs, P. L. *J. Org. Chem.* **1983**, *48*, 2167.
(7) Corey, E. J.; Hopkins, P. B.; Kim, S.; Kou, S.; Nambiar, K. P.; Flack, J. R. *J. Am. Chem. Soc.* **1979**, *1901*, 7131.
(8) Curran, D. P.; Brill, J. F.; Rakiewicz, D. M. *J. Org. Chem.* **1984**, *49*, 1654.
(9) Barhate, N. B.; Gajare, A. S.; Wakharkar, R. D.; Sudalai, A. *Tetrahedron Lett.* **1997**, *38*, 653.
(10) Loupy, A.; Bram, G.; Villemin, D. *Solid Support and Catalysts in Organic Synthesis* ; Smith, K., Ed.; Ellis-Harwood: Chichester UK, **1992**, Chap. 12, 302–326.
(11) Khazaei, A.; Shirdarreh, A. *Synth. Commun.* **1999**, *29*, 4079.