

Research Note

SOLID STATE DESEMICARBAZONATION WITH HEXAMETHYLENETETRAMINE-BROMINE: REGENERATION OF CARBONYL COMPOUNDS USING MICROWAVES

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Abstract

Hexamethylenetetramine-bromine on wet alumina rapidly regenerates carbonyl compounds from their corresponding semicarbazone using microwave under solventless system.

Semicarbazones are used not only for isolation and purification, but also for protection of carbonyl compounds during multi-step synthesis [1,2]. Several methods for regenerating carbonyl compounds from semicarbazones have been reported such as treatment with phthalic anhydride [1], pyruvic acid [3], nitrous acid in acetic acid [4], concentrated hydrochloric acid, cation exchange resin [5,6] thallium (III) nitrate [7], benzeneseleninic acid [8], cerium ammonium nitrate [9], clay supported iron (III) nitrate [10], titanium chloride [11], potassium bromate [12], thallium acetate [13], pentane -2,4-dione in dilute hydrochloric acid [14], tetrakis (pyridine) silver dichromate [15], copper (II) chloride dehydrate [16], chlorotrimethylsilane

Keywords: Desemicarbazonation; Hexamethylenetetramine bromine; Solid state; Wet alumina; Microwave irradiation nitrite or nitrate [17], ammonium persulfate-clay [18] and others [19].

Although some of these methods are carried out under mild conditions, most of them require strong acidic media, or a strong oxidizing agent, and sometimes, long reaction periods. Thus, there is still a great demand to develop a new and facile procedure for the regeneration of carbonyl compounds from semicarbazones.

In recent years, the organic reactions that are assisted by microwaves [20], especially under solventless conditions [21], have attracted attention because of their enhanced selectivity, milder reaction conditions and associated ease of manipulation.

In continuation of our ongoing efforts in microwave assisted reactions [22], we wish to report a simple oxidative cleavage of semicarbazones with hexamethylenetetramine-bromine on wet alumina in solventless system which is accelerated by microwaves.

Hexamethylenetetramine-bromine is an inexpensive reagent which has been recently reported as an oxidizing agent [23]. However, there is no report in

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literature that describes its application in other oxidative cleavages. Consequently, we decided to explore the oxidative cleavage of the imine-type moieties using hexamethylenetetramine-bromine. In the absence of alumina, the attempted cleavage of semicarbazones failed with hexamethylenetetramine-bromine under both thermal as well as microwave irradiation even after prolonged reaction periods. In view of established beneficial effects of the reagents on minerals [24], we examined a variety of minerals such as montmorillonite K-10, silica and alumina with hexamethylenetetramine-bromine and found that alumina provides clean regeneration of the corresponding aldehydes. However, in this condition the reaction was sluggish and took 6 h to be completed. Recently, use of wet alumina as a support along with microwave irradiation has been reported [22,24]. Armed with these experiences, hexamethylenetetramine-bromine was intimately mixed with an equivalent weight. When this supported reagent was mixed thoroughly with semicarbazone of acetophenone with a spatula, the reaction was completed in 30 sec under the influence of microwaves, confirmed by TLC (hexane, EtOAc, 8:2) Entry 2, Table 1). To establish generality of the method, semicarbazones of aldehydes and ketones were used under the above condition.

In conclusion, we have developed a solid state method for the facile desemicarbazone of protected aldehydes and ketones using hexamethylenetetramine-bromine under microwave irradiation. The reagent

ordinary exposure to light, air or water and has no offensive odour of bromine or amine.

Experimental Section

All compounds are known and characterized with their physical and spectroscopic data by comparison with those of authentic samples. In view of the hazards associated with an oxidant and evolution of gases during the reaction, caution is recommended for its use at elevated temperatures. We suggest that the microwave oven be operated carefully and for a shorter time due to the possibility of a high localized temperature.

Regeneration of Acetophenone from Semicarbazone of Acetophenone:

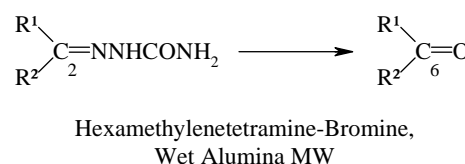
Typical Procedure

Wet alumina (10 g) was shaken with distilled water (2 ml). The reagent was prepared by mixing hexamethylenetetramine-bromine (0.2 g) with wet alumina (0.2 g). This supported reagent (0.4 g) was added to semicarbazone acetophenone (0.177 g, 1 mmol) and mixed thoroughly using a spatula. The reaction mixture was subjected to microwave irradiation for 30 sec (as monitored by TLC). The product was extracted into dichloromethane (3×30 ml) and alumina was removed via filtration through a sintered glass funnel. The solvent from the combined extracts is removed under reduced pressure and the crude product is passed through a bed of silica gel using hexane-EtOAc, 8:2 as eluents to afford the product (Table 1).

Table 1. Cleavage of semicarbazones with hexamethylenetetramine-bromine under microwave irradiation in solventless system

Entry	R ¹	R ²	Reaction time (sec)	Yield %
1	C ₆ H ₅	H	80	88
2	C ₆ H ₅	CH ₃	30	92
3	C ₆ H ₅	C ₆ H ₅	100	70
4	p-Cl-C ₆ H ₄	H	80	90
5	o-Cl-C ₆ H ₄	H	60	85
6	m-Cl-C ₆ H ₄	H	60	80
7	o-NO ₂ -C ₆ H ₄	H	60	75
8	p-OH-C ₆ H ₄	H	50	85
9	Cyclohexyl		60	85
10	CH ₃	C ₂ H ₅	30	90
11	CH ₃ CH=CH	H	30	80

could be readily prepared by adding bromine to a chloroform solution of commercially available amine [23]. This homogenous non-hygroscopic solid is very stable at room temperature and is not affected by



References

- Gillman, A. E. and West, T. F. *J. Chem. Soc.*, **95**, (1945).
- Kirk, D. N. and Stade, C. F. *Tetrahedron Lett.*, **21**, 651, (1980).
- Hershberg, E. B. *J. Org. Chem.*, **13**, 542, (1948).
- Goldsmid, T. and Veer, W. L. C. *Recl. Trav. Chim. Pays-Bas.*, **65**, 796, (1916).
- Ranu, C. and Sarkar, C. C. *J. Org. Chem.*, **53**, 878, (1988).
- Ballini, R. and Petrini, M. *J. Chem. Soc., Perkin Trans.*, **1**, 2563, (1988).
- McKillop, A., Hunt, J. D., Naylor, E. D. and Taylor, E. C. *J. Am. Chem. Soc.*, **93**, 4918, (1971).
- Barton, D. H. R., Lester, D. J. and Ley, S. V. *J. Chem. Soc. Chem. Commun.*, 445, (1977).
- Bird, J. W. and Diaper, G. M. *Can J. Chem.*, **47**, 145,

- (1969).
10. Laszlo, P. and Polla, E., *Synthesis*, 439, (1985).
 11. Vakatkar, V. V., Tatake, J. G. and Suthanker, S. V., *Chem. Ind. (London)*, 742, (1977).
 12. Narayanan, S. and Srinivasan, S. *J. Chem. Soc. Perkin Trans.*, **2**, 1557, (1986).
 13. Butler, R. N., Morris, G. J. and O'Donohue, A. M. *J. Chem. Res. (S)*, **61**, (1981).
 14. Ried, W. and Muhle, G. *Liebigs Ann. Chem.*, **656**, 119, (1962).
 15. Firouzabadi, H., Seddighi, M., Ahmadi, A. and Sardarian, A. R. *Synth. Commun.*, **19**, 3385, (1989).
 16. Ram, R. N. and Varsha, K. *Tetrahedron Lett.*, **32**, 5829, (1991).
 17. Khan, R. H., Mathur, R. K. and Ghosh, A. C. *J. Chem. Res. (S)*, 506, (1995).
 18. Varma, R. S. and Mosbram, H. M. *Tetrahedron Lett.*, **38**(45), 7973, (1997).
 19. Fieser, L. F. and Fuser, M. *Reagents for organic synthesis*, Wiley-Intersciences, New York, Vol. 2, p. 65, (1969).
 20. For recent reviews on microwave-assisted chemical reactions, see a) Abramovich, R. A. *Org. Prep. Proced. Int.*, **23**, 683, (1991); b) Whittaker, A. G. and Mingos, D. M. P. *J. Microwave Power Electromagn. Energy*, **29**, 195, (1994); c) Zhang, G. S., Tong, H. and Yang, H. *Synth. Commun.*, **29**, 1165, (1999); d) Bose, D. S. and Narsaiah, V. *Synth. Commun.*, **29**, 937, (1999).
 21. a) Varma, R. S., Dahiya, R. and Kumar, S. *Tetrahedron Lett.*, **38**, 2039, (1997); b) Varma, R. S. and Saini, R. K. *Ibid.*, **38**, 4337, (1997); c) Varma, R. S., Dahiya, R. and Kumar, S. *Ibid.*, **38**, 5131, (1997); d) Varma, R. S., Saini, R. K. and Meshram, H. M. *Ibid.*, **38**, in press, (1997); e) Varma, R. S. and Meshram, H. M. *Ibid.*, **38**, 5427, (1997); f) Varma, R. S. and Saini, R. K. *Synlett.*, 856, (1997).
 22. a) Heravi, M. M., Aghapoor, K., Nooshabadi, M. M. and Mojtahidi, M. M. *Monatsh. Chem.*, **128**, 1143, (1997); b) Aghapoor, K., Heravi, M. M. and Nooshabadi, M. A. *Indian J. Chem.*, **37B**, 84, (1998); c) Heravi, M. M., Kiakoojour, R. and Tabar Hydar, K. *J. Chem. Res.*, **656**, (1998); d) Heravi, M. M., Ajami, D., Aghapoor, K. and Gassemzadeh, M. *Chem. Commun.*, 833, (1999).
 23. a) Yavari, I. and Shaabani, A. *J. Chem. Res. (S)*, 274, (1994); b) Heravi, M. M., Ajami, D. and Nooshabadi, M. *Iran. J. Chem. & Eng.*, in press, (2000).
 24. Varma, R. S. and Saini, R. K. *Tetrahedron Lett.*, **39**, 1481, (1998).