Deoxygenation and dehydratization of ketoximes and ketophenylhydrazones by wet HMT in solid state under microwave conditions

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A time and energy efficient process of generation of ketones from oximes and phenylhydrazones is reported under microwave irradiation utilizing inexpensive and easily available reagent – hexamethylenetetramine under solvent-free condition with high yields.

Considerable recent research endeavour in the field of chemistry have focussed on Microwave – induced Organic Reaction Enhancement (MORE) chemistry. The generation of carbonyl compounds from oximes and phenylhydrazones, the highly stable compounds, is being studied till today for their importance in synthetic organic chemistry. Some of the methods of earlier reports for deoxygenation involve periodic acid, aqueous TiCl3 and acetic acid, pyridinium chlorochromate, pyridinium chlorochromate – H2O2, alkali H2O2, triethylammonium chlorochromate, Raney nickel, chromic anhydride – chlorotrimethylsilane, LiAlH4-HMPA, dinitrogen tetraoxide, Dowex-50, Amberlyst 15 and acetone, pyridinium dichromate- t-BuOOH, dimethyl dioxirane, t-butyldihydroperoxide, ammonium persulphate-silica, manganese tetracetate, N-haloamides, sodium periodate-silica, Des-Martin periodinane, sodium bismuthate silica etc. Some of these reagents suffer from one or the other disadvantages like difficulties in isolation of products, long reaction time and also lacking easy availability causing explosion under excessive heating during preparation. Moreover, many of the reactions were carried out in the presence of organic solvents, a number of which are generally toxic to living beings.

Some of the reagents reported earlier for dehydratization of phenylhydrazones are acetylacetone- HCl, MnO2, acetone, clay-ferric nitrate, 3-carboxy pyridinium chlorochromate, ammonium persulphate and formic acid. Several of these methods involve some drawbacks like the use of excessive reagents, production of fair amount of byproduct, long reaction time (100 hr), methods applied for one example only, use of specialised noncommercial reagent besides the involvement of organic solvents in most of the reactions. So the search for faster and solvent-free reaction condition using new reagent is the goal of chemists.

The solvent-free reactions are especially appealing for providing an eco-friendly system. So the well-established potentiality of microwave irradiation has been exploited for generation of ketones from oximes and phenylhydrazones under solvent-free condition. We report herein for the first time the application of an inexpensive and easily available reagent, hexamethylenetetramine (HMT) for the deprotection reaction (Scheme 1). The reagent is moistened with water to absorb the heat efficiently as water is highly microwave active. The reactions were usually completed within 17-80 seconds at power level 5 (600 W) and resulted 70-89% yield (Table I).

![Scheme 1](image)

The use of this new technique (MORE chemistry) is justified by the little time required for the reaction and by the high yields of the reaction products obtained and also by the wide applicability towards aliphatic, aromatic, cyclic ketones and diketone derivatives. Moreover, the absence of organic solvent makes the reaction condition environment-friendly compared to the conventional methods. Besides, the easy availability of the reagent, other advantages of this process are: faster, cleaner reactions resulting from less thermal decomposition of products and minimisation of secondary processes under microwave irradiation and solvent-free condition reflect it as a cost effective environmentally-benign method.

Experimental Section

IR spectra were recorded on a Perkin-Elmer 782 spectrophotometer; and 1H NMR spectra on a Bruker AM 300L spectrometer operating at 300 MHz using...
Table I—Results of microwave-assisted deprotection in solid state

<table>
<thead>
<tr>
<th>Entry</th>
<th>Product*</th>
<th>Oximes</th>
<th>Phenylhyrazones</th>
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<tr>
<td></td>
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<td>Time period (sec)</td>
<td>Yield (%)</td>
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<td>78</td>
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* Isolated yield.

TMS as an internal standard. The reactions were carried out in a domestic microwave oven (BPL-SANYO, BMO-700T, 2450 MHz).

General procedure. A mixture of oxime / phenylhydrazone derivative (1 mmole) and HMT (2 mmoles) moistened with water (0.5 mL) was taken in a 25 mL Erlenmeyer flask. The flask was then placed in an alumina bath (heat sink) inside a domestic microwave oven operating at medium power level (600 W) and irradiated for the specified time period (Table I). After completion of the reaction (monitored by TLC) the product was extracted with dichloromethane (2×5 mL) and washed with brine and dried over anhydrous sodium sulphate. Evaporation of the solvent followed by the filtration on a short silica gel column afforded the pure product. All the compounds obtained were characterised by 1H NMR spectra and by comparison of their IR spectra with authentic samples.

In conclusion, we have illustrated a solvent-free, cost effective and eco-friendly method for the generation of ketones from ketoximes and ketophenylhyrazones under microwave irradiation using HMT.

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References and Notes

32 To arrest the low boiling product from evaporating off (entry 1), reaction was carried out in an Erlenmeyer flask fitted with a funnel as a loose top, upon which a round bottomed flask containing ice was placed for serving as a condenser.