



Microwave Assisted Deprotection of Heterocyclic Semicarbazones by Quinolinium Flurochromate

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The regeneration of semicarbazone from 2,6-diphenyl piperidine-4-one semicarbazone (PPS) and its alkyl substituted derivatives (3, 3 and 5th position) by quinolinium flurochromate (QFC) under microwave irradiation in the presence of montmorillonite K10 clay leads to the formation of ketone in a good yield.

Keywords: Piperidine 4-one semicarbazone, Quinolinium flurochromate, Microwave irradiation.

INTRODUCTION

Nitrogen derivatives of aldehydes and ketones such as oximes and semicarbazones are highly crystalline compounds. They constitute a very efficient method for the isolation, purification and characterization of carbonyl compounds [1-3]. In contrast to oximes, little attention has been paid for the conversion of semicarbazones into their carbonyl compounds and the number of effective methods for this reaction mixture remains quite limited. A number of procedures exist including direct acid hydrolysis and acid catalyzed exchange with pyruvic acid, levulic acid, *etc.* However, most of the procedures used for this type of reaction require the use of solid support or other auxiliaries, solvents for the extraction from the solid supports, high temperature, long reaction time, expensive and not readily available reagents and tedious work-up procedures. Consequently, there is a demand for the development of this process using readily available reagents, which operate under extremely mild reaction conditions. Microwave irradiation is a simple, rapid and efficient solvent free method for the deprotection of semicarbazones to carbonyl compounds [4].

Quinolinium flurochromate (QFC), in Cr(IV) oxidant series is one of the efficient and interesting oxidizing agent [5]. Quinolinium flurochromate is found to have several advantages over similar oxidizing agents due to its special characteristics such as less acidity, better solubility in non-aqueous solvents, shorter reaction times and forming products in high yield. It behaves as two electron oxidant in majority of the reactions so far studied. Bosh and Narasaiah [6] have reported the conversion of C=N double bond of oximes, semicarbazones, tosyl hydrazones and N,N-dimethyl hydrazones to yield the corresponding carbonyl compounds in good to excellent

yields. The reagents have also been successfully applied to the oxidation of selected alcohols and oxime to the corresponding carbonyl compounds in dichloromethane solvent under reflux condition [7]. The oxidation reactions have been found to be smooth and gave the products in good yields [8].

Montmorillonite clay known as a Brønsted acid have a great impact on organic synthesis [9,10]. These solid supports with lamellar swelling structure and large surface area enhance selectivity in synthetic organic chemistry. Avoiding organic solvents during the reaction in organic synthesis lead to a clean, efficient and economical technology [11-13]. In solid state reaction, work-up is considerably simplified, cost is reduced and increased amounts of reactants can be used in the same equipment.

Microwave chemistry is the science of applying microwave radiation to chemical reactions. Microwave acts as high frequency electric fields and generally heat any material containing mobile electric charges, such as polar molecules in a solvent or conducting ions in a solid. Regeneration of carbonyl groups from semicarbazones can be accomplished under microwave irradiation. Application of microwave irradiation in chemical reactions is due to the fact that the microwave approach contribute to the much provided reaction conditions, higher chemical yield, lower energy usage and formation of cleaner products and so deprotection of semicarbazones using microwave irradiation is a green process [14-16].

EXPERIMENTAL

Quinoline was distilled at its boiling point. Chromium trioxide, hydrofluoric acid, semicarbazide hydrochloride, silica gel, dichloro methane, diethyl ether, petroleum ether, montmorillonite clay K10 and ethyl acetate were used as such (Analar grade).

Quinolinium flurochromate (QFC), a complex of chromic acid, quinoline and hydrogen fluoride was prepared as suggested by Murugesan and Pandurangan [5]. Chromium(VI) oxide (15 g: 0.15 mol) was dissolved in water (25 mL) in a polythene beaker and 40 % hydrofluoric acid (11.3 mL:0.23 mol) added to it with stirring at room temperature. To this clear solution, distilled quinoline (17.7 mL:0.15 mol) was added slowly with stirring. The mixture was heated on a steam-bath for 0.5 h, then cooled to room temperature and allowed to stand for 1 h. The bright red-orange crystalline quinolinium flurochromate was isolated by filtration and dried *in vacuo* for 1 h (m.p. 163 °C and 162-163 °C) [5]. All semicarbazones were prepared from the respective ketones by the reported procedure [17,18].

Microwave irradiation process: 3-Alkyl-2,6-diphenyl piperidin-4-one (2 mmol) semicarbazone was mixed with quinolinium flurochromate (4 mmol) with 2 g of montmorillonite clay K10 and irradiated in microwave oven (LG. model No. MH2043DW) for an appropriate time. The progress of the reaction was monitored by thin layer chromatography. After completion of the reaction the product recovered by passing the reaction mixture through column chromatography of silica. (200-300 mesh, eluted with mixture of petroleum ether and ethyl acetate).

Separation of product by column chromatography: A column of 5 × 1 cm was packed with silica gel by making slurry with dichloromethane. It was dried in an oven and used for

TABLE-1

Substrate	Product	Time of irradiation (min)	Yield (%)	m.p. (°C)	
				Literature	Observed
		10	70	104	103
		15	90	86-87	85
		20	90	107	106
		25	90	114-115	114
		30	75	133-134	133
		30	80	125-126	124

eluting the products. The product dissolved in dichloromethane and diethyl ether (9:1). After repeated eluting and washing the fractions obtained were collected together and evaporated to get the solid ketone.

RESULTS AND DISCUSSION

The product was identified by determining their melting point. A qualitative test was also carried out to confirm the formation of ketone (Table-1).

Thin layer chromatography: TLC plate is prepared by dipping it in slurry of silica gel in benzene. Petroleum ether-ethyl acetate mixture (9:1) is used as an eluent. It is observed that the R_f values of semicarbazones and their corresponding ketones formed in the oxidation process are found to be different while that of pure ketone and the product ketone are found to be the same indicating the formation of ketone.

FTIR spectral analysis of 3-alkyl-2,6-diphenyl piperidin-4-one semicarbazones: In FTIR spectral analysis of 3-methyl-2,6-diphenyl piperidin-4-one semicarbazone and 3-ethyl-2,6-diphenyl piperidin-4-one semicarbazone, the intense sharp peak at 1698.07 and 1686 cm^{-1} are due to the presence of imine sites, respectively. The stretching vibrations at 757.40 and 697.13 cm^{-1} and 760.41 and 679.89 cm^{-1} show the presence of phenyl ring. The peaks at 1480.62 and 1443.52 cm^{-1} are due to C-H bending vibration of alkyl groups in 3-methyl-2,6-diphenyl piperidin-4-one semicarbazone and 3-ethyl-2,6-diphenyl piperidin-4-one semicarbazone. The secondary N-H groups of 3-methyl-2,6-diphenyl piperidin-4-one semicarbazone and 3-ethyl-2,6-diphenyl piperidin-4-one semicarbazone exhibit vibrations at 3470.40 and 3454.32 cm^{-1} .

In the FTIR spectra of 3-isopropyl-2,6-diphenyl piperidin-4-one semicarbazone (3-iprPPS), the intense peak at 1678.77 cm^{-1} is due to the presence of imine site. The stretching vibrations at 759.63 cm^{-1} and 697.60 cm^{-1} show the presence of phenyl ring. The peak at 1441.55 cm^{-1} is due to the presence of C-H bending vibration of isopropyl group of 3-iprPPS, the secondary N-H group of 3-iprPPS exhibit vibrations at 3408.78 cm^{-1} . The sharp peaks at 1700.45, 1705.69 and 1701.09 cm^{-1} are due to the carbonyl groups present in corresponding ketones. Formation of ketone as a product is further confirmed by the blue shift in λ_{max} value of UV-visible spectrum of semicarbazones to ketones [19,20].

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