SHORT PAPER

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A convenient synthesis of azines under solvent-free conditions using microwave irradiation†

Hossein Loghmani-Khouzani*, Majid M. M. Sadeghi, Javad Safari, Mohammad S. Abdorrezaie and Masood Jafarpisheh

Department of Chemistry, Faculity of Sciences, University of Isfahan, Isfahan 81744, I. R. Iran

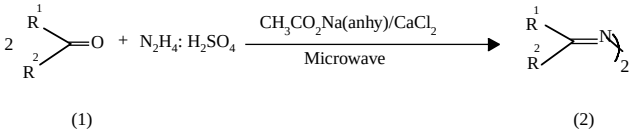
In an extremely fast method the reaction of hydrazine sulfate with a number of aldehydes and ketones, is accelerated by microwave irradiation under solvent free conditions in the presence of CH_3CO_2Na /$CaCl_2$ to afford high yields of relevant azines.

Keywords: azines, aldehydes, ketones

Azines, $R^1R^2C{=}N{-}N{=}CR^1R^2$, have achieved significance in organic synthesis.[1,2] Many studies have shown that azines are good synthons for heterocyclic synthesis including as pyrazoles, purines and pyrimidines.[3] These compounds can be employed for some useful synthetic transformations,[4] and possess some unexpected biological activities.[5] The ability of azines derived from 2-pyridine carbaldehyde to as act a polydentate ligand to form very stable complexes with different cations is known.[6]

The usual method for the preparation of azines involves treatment of carbonyl compounds with hydrazine hydrate and acetic acid in ethanol.[7,8] However, this method suffers from disadvantages including low yield and mixtures of product, long reaction time, and the difficulty of operating conditions.

Microwave-assisted organic synthesis has recently received considerable attention by synthetic chemists[9–13] because of its high efficiency and convenient workup conditions. Herein, we wish to report for the first time the use of $CH_3CO_2Na/CaCl_2$ in the preparation of azines in dry media coupled with microwave irradiation. Hydrazine sulfate was reacted with several aliphatic and aromatic aldehydes and ketones (Scheme 1) offering the desired azines:



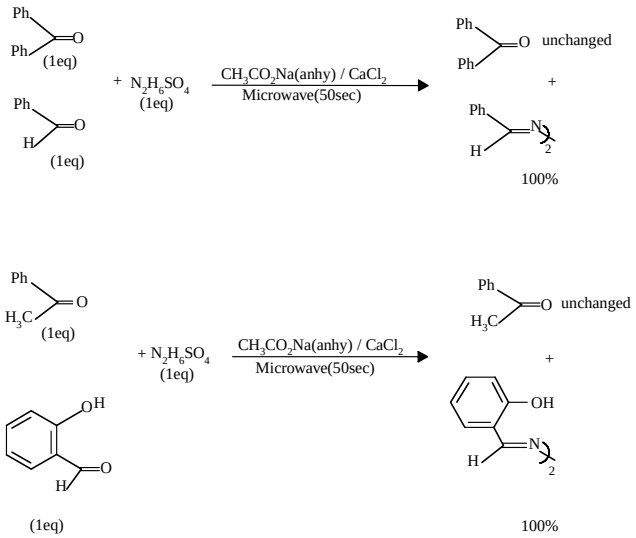
(1) (2)

Scheme 1

The reactions were very fast and were completed in 1–8 minutes. The use of $CH_3CO_2Na/CaCl_2$ in dry media coupled with microwave irradiation was demonstrated various aldehydes and ketones with hydrazine sulfate. The resulting data are summarised in Table 1. Aromatic and α,β-unsaturated aldehydes were converted to the correspounding azines in >90% yield in less than 2 min (entries 1–6). For ketones reaction were difficult and low yields were obtaind (entries 7–14).

The purity of the products was determined by ^{1}H NMR, IR spectra and melting point. In the ^{1}H NMR spectra of the aldehyde-azines, the CH signal of the HC=N- appeared around δ 8.0–9.0 as a singlet and in the IR spectra, the C=N group was observed around 1610–1650 cm^{-1}.

Another noteworthy feature of the method lies in the exclusive reaction of aldehydes with hydrazine sulfate despite the presence of ketones. When equivalent amounts of ketones, aldehydes and hydrazine sulfate were reacted, the aldehydes were selectively converted to the corresponding azines whereas the ketones did not react at all (Scheme 2).



Scheme 2

In conclusion, the reported procedure is an interesting, easy and novel method for the preparation of azines. In addition, high yields of products, short reaction time, ease of workup conditions, and low cost make the above method preferable to other existing methods.

Experimental

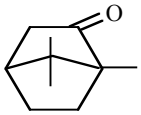
All yields refer to isolated products. The products were purified by column chromatography or preparative TLC and recrystallization from ethanol. Melting points were determined by Buchi 510 apparatus and were not corrected. IR spectra were recorded on Prekin Elmer 781 spectrophotometer, ^{1}H NMR spectra on Bruker WP 80 spectrometer. microwave irradiation was carried out with Samsung microwave (2450 MHz 900W).

General procedure for the preparation of azines: In a typical experiment, a mixture of 0.212 g (2 mmol) of benzaldehyde and 0.13g (1 mmol) of hydrazine sulfate was placed in an open glass container; sodium acetate anhydrous/calcium chloride (0.3g + 0.3g) was added and the mixture was irradiated in a microwave oven for 30 s (Table 1) when the reaction was complete. The mixture was cooled to room temperature; water (15ml) added and the solution was extracted with chloroform (3 × 5 ml). The combined extracts were dried on $MgSO_4$ and evaporation of solvent under vaccum gave benzalazine which was ≥98 % pure (TLC, ^{1}H NMR, IR and m.p.).

* To receive any correspondence. e-mail: h.log119@sci.ui.ac.ir

† This is a Short Paper, there is therefore no corresponding material in *J Chem. Research (M).*

Table 1 Synthesis of azines from aldehydes and ketones under microwave irradiation

Entry	R^1	R^2	Power/W	Time/s	Yield/%[a,b]
1	Ph	H	600	30	98
2	4-$MeOC_6H_4$	H	600	40	97
3	2-HOC_6H_4	H	600	40	95
4	3-NO2C_6H_4	H	600	130	94
5	4-$Me_2NC_6H_4$	H	600	100	97
6	PhCH = CH	H	600	100	95
7	Ph	CH_3	700	160	85
8	Ph	Ph	900	480	80
9	PhCH(OH)	Ph	900	480	80
10	PhCO	Ph	900	480	85
11	2-quinaldyl	Ph	900	480	15
12	2-quinaldyl	t-C_4H_9	900	480	35
13	-$(CH_2)_5$-		900	360	75
14			900	360	72

[a]All products were identified by comparison with authentic samples (IR, NMR, m.p.).

[b]Isolated yields.

Table 2 Melting points of azines

Entry	Found (m.p.°C)	Reported (Bielstin)
1	92–93	93 benzalazine
2	174	172–175
3	216	216–217
4	195–196	194–197
5	215	215–217
6	163	162
7	123	122
8	161–162	162
9	157	157
10	202–203	202
11	168	167
12	173	172–173
13	35–37	37
14	186	185–186 camphorazine

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