Research Article

Microwave- Assisted Synthesis of (2e)-3-Phenyl Prop -2-Enol Analogs and Comparison with Conventional Method of their Synthesis

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ABSTRACT

A novel and simple method have been developed for the synthesis of some (2E)-3- phenyl prop -2-enol (cinnamaldehyde) analogs under microwave irradiation. In addition these compounds were obtained with conventional heating procedures to compare them with those obtained with microwave irradiation. All the compounds synthesized were characterized by running TLC, UV, IR & MS spectra. Consequently, the microwave irradiation method provided nearly the same or higher product yields in a very short period of time. These results suggest that the microwave irradiation method was more useful than the conventional method due to shorter reaction time and energy savings.

Keywords: cinnamaldehyde, microwave, TLC, UV, IR, MS.

INTRODUCTION

The synthesis and structure of Schiff bases have attracted much attention in chemistry and biology[1]. In 1864 Schiff Hugo Josef first discovered Schiff bases as compounds including the carbon-nitrogen double bond[2]. They usually synthesize from a primary amine and a carbonyl compound by nucleophilic addition forming a hemiaminal, followed by dehydration to generation imine [2]. Schiff bases have been widely studied as ligands in the field of coordination chemistry mainly due to their facile synthesis, nitrogen easily availability, electronic properties and good solubility in common solvents [3, 4]. For example, some Schiff bases derived from benzoin, salicylaldehyde, amino phenol and 2, 4 dinitrophenyl hydrazine have antitumor activity or has anticancer potential. Therefore, the synthesis of Schiff bases still is important and interesting for chemists. We describe synthesis of three new Schiff bases cinnamaldehyde[5] using n-Hexane as solvent.

Cinnamaldehyde occurs naturally in the bark of Cinnamon zylanicum of family laureaceae[6]. Cinnamaldehyde was isolated from cinnamon essential oil in 1834 by Dumas and Peligot and synthesized in the laboratory by Chiozza in 1854. The important uses of cinnamaldehyde are antimicrobial, fungicide, mild astringent, anti-septic[7] etc.

Microwave assisted organic synthesis is a technique which can be used rapidly explore chemistry space and increase the diversity of the compound produced. Now a day, it could be considered that all of the previously heated reactions could be performed using this technique[8]. When a molecule is irradiated with microwaves it will attempt to align itself with electric field by rotation. If the frequency of molecular rotation is similar to the frequency of microwave radiation (2.45GHz), the molecule will continually align and realign with the oscillation field; therefore, the molecule absorb the electric energy[9].

Microwaves have been employed in organic chemistry to reduce the reaction times from hours to minutes, to increase yields and selectivity. Under the work of green chemistry on the application of microwave to organic synthesis we have developed an environmentally benign method for synthesizing cinnamaldehyde analogs[10].

EXPERIMENTAL METHODS

1. In silico molecular study

In silico molecular study of the probable derivatives was determined whether all the candidates will follow the Lipinski Rule of '5' is carried out. Different soft wares like ACD/ILAB, Mol inspiration were employed to determine the physicochemical descriptors are given in Table 1.

2. Experimental procedure

Method I (conventional method)[11-13]

2.1 Synthesis of (1*E*, 2*E*)-*N*, 3-diphenylprop-2-en-1-imine: Cinnamaldehyde (0.01 mol) and Aniline (0.01 mol) were refluxed in 50 ml of n-Hexane. UV λ max (methanol) 394 nm, IR (KBr): 1725, 1630, 1513, 1462, 1251, 791 $cm^{-1,}$ MS m/z 207 [M^+ 100%]. The synthetic route is represented in Scheme 1 and physical data and elemental analysis of the synthesized compounds are given Table 2 and Table 3.

2.2. Synthesis of 4-{(*E*)-[(2*E*)-3-phenylprop-2-en-1-ylidene] amino} phenol: Cinnamaldehyde (0.01 mol) and 4-amino phenol (0.01 mol) were refluxed in 50 ml of n-Hexane. UV λ max (methanol) 383 nm; IR (KBr): 3370, 1739, 1590, 1509, 1250, 833, 791 $cm^{-1,}$ MS m/z 223[M^+ 100%].

2.3. Synthesis of (1*E*, 2E)-*N*-(4-chlorophenyl)-3-phenylprop-2-en-1-imine: Cinnamaldehyde (0.01 mol) and 4- chloro aniline (0.01 mol) were refluxed in 50 ml of n-Hexane. UV λ max (methanol) 373 nm; IR (KBr): 1725, 1630, 1513, 1462, 1251, 791 $cm^{-1,}$ MS m/z 241[M^+ 100%].

Method II (Microwave method) [14-17]: Cinnamaldehyde and substituted aromatic amines were irradiated in a domestic microwave oven (Kenstar, Model No. OM-26 E 60, Power-1200 W) at different powers and time without the use of solvent. Melting points were determined in open capillaries and are uncorrected. Reactions were monitored by thin layer chromatography using silica gel- G as adsorbent. TLC plates were prepared by spreading method. These were dried in the air and then activated by heating in hot air oven at 110°C for 30 min. Iodine vapours were used for visualization of TLC plates. IR spectra (KBr pellets) were recorded on perkin-Elmer 1800 (FTIR) Spectrometer. Mass spectra were recorded on a Jeol SX- 102/DA 6000 mass spectrometer.

RESULTS AND DISCUSSION

Conventional method for the synthesis of these compounds requires 2-6 hours reflux and suitable solvents with catalytic amount of n-hexane. Thus, conventional method is time taking and therefore, these are not ecofriendly. However, when the same reaction was carried out in microwave, the reaction time is reduced. However, present work making the use of n-hexane as solvent have been avoided and reaction time has also been found to be reduced as compared to conventional methods. The yield of products was also increased. Therefore, the present work may be regarded as a green approach under solvent free conditions. The reaction has been carried out by grinding appropriate reactants and then exposing the reaction mixture under microwave irradiation. The progress of reaction was monitored by thin layer chromatography using silica gel G as stationary phase [Benzene: ethyl acetate: acetic acid, 9:0.5:0.5] as mobile phase. Structures of compounds were characterized by IR, and mass spectral data. All the imines show the characteristic band around 1620 cm^{-1} for C=N stretching and C=C stretch around 1720-1740 cm^{-1}. A comparison of time required for synthesis and yield of products in conventional and microwave method has been reported in Table-1.

CONCLUSION

We first performed the synthesis of (2E)-3-phenyl prop-2-enol by conventional heating as depicted in Scheme 1 but to reduce the reaction time, it was decided to synthesize the compounds with microwave irradiation. By the microwave irradiation all the three compounds were prepared in yield that was appreciably higher than the conventional methods. The quality of the product formed was found to be better showing less number of impurities on TLC when compared to the conventional products. The yield of the compound Cinnan 2 via microwave irradiation was higher i.e. 91% than that of the conventional method.

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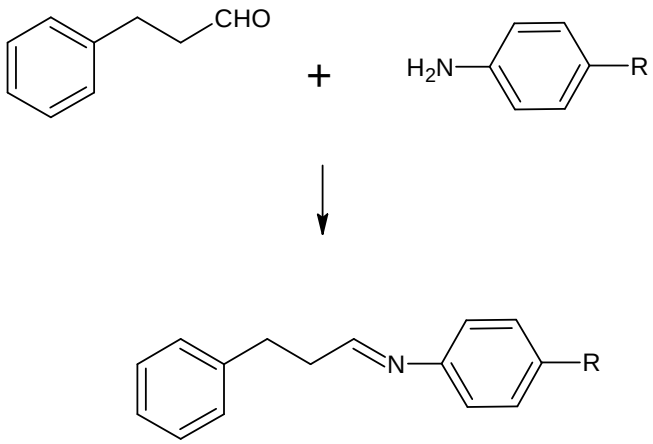
Table1: Physicochemical parameters

Compound	Molecular formula	Formula Weight	Molar refractivity	Molar volume	Polarizability
Cinnan1	$C_{15}H_{15}N$	209.28	69.63±0.5cm^2	221.7±7.0cm^3	27.60±0.5cm^2
Cinnan2	$C_{15}H_{15}NO$	225.28	70.48±0.5cm^2	219.0±7.0cm^3	27.94±0.5cm^2
Cinnan3	$C_{15}H_{14}ClN$	243.73	74.23±0.5cm^2	231.0±7.0cm^3	29.42±0.5cm^2



Scheme 1

Table 2: Characterization & Comparison of Conventional and Microwave synthesis of compounds

Compound	MP (^{0}C)	Rf	Yield(%) time/hr method I	Yield(%) time/min method II, power
Cinnan1	140-142	0.337	75(2.00)	96(1min), P60
Cinnan2	160-162	0.85	60(6.00)	91(8 min), P80
Cinnan3	88-90	0.376	80(4.00)	94 (6 min), P80

Table 3: Elemental analysis of synthesized compound

Compound	Composition found/calculated%		
	C	H	N
Cinnan1	86.08/86.01	7.22/7.13	6.69/6.54
Cinnan2	79.97/79.82	6.71/6.65	6.22/6.14
Cinnan3	73.92/73.80	5.79/5.66	5.75/5.70

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