INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com ISSN 2230 – 8407

Research Article

STUDIES ON MICROWAVE ASSISTED SYNTHESIS OF SOME SCHIFF BASES

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Article Received on: 17/10/13 Revised on: 01/11/13 Approved for publication: 10/11/13

DOI: 10.7897/2230-8407.041122

IRJP is an official publication of Moksha Publishing House. Website: www.mokshaph.com

ABSTRACT

The microwave assisted organic synthesis is becoming very popular in recent years owing to its merits over the conventional methods. Some reactions in which conventional heat do not promote are facilitated by microwave irradiation. It is economical, environmentally benign and rapid. We have exploited microwaves for synthesis of some Schiff bases (1a to 1h) by condensing various substituted aromatic aldehydes with hydrazone, obtained by reacting 2-acetyl naphthalene with hydrazine hydrate in the presence of glacial acetic acid. A considerable increase in the reaction rate has been observed with better yield in microwave technique compared to the conventional method. The structures of all the synthesized compounds have been characterized on the basis of Physical constants (m.p, R_f value) and Spectral data {IR (KBr, cm^{-1}), ^{1}HNMR (δppm)}.

Keywords: Two pot synthesis, Microwave irradiation, Reaction time, Schiff bases.

INTRODUCTION

Green Chemistry is an invention, design, development and application of chemical products and processes to reduce or to eliminate the use and generation of substances hazardous to human health and environment. Microwave assisted organic synthesis is one such component of green chemistry. In recent years microwave assisted organic synthesis has emerged as frontier devised to speed up the chemical reactions in the pharmaceutical research for the synthesis of newer drugs[1]. Microwave reactions under solvent free conditions are attractive in offering reduced pollution, low cost and offer high yields together with simplicity in processing and handling[2]. The salient features of microwave assisted synthesis are shorter reaction times, simple reaction conditions and enhancement in chemical yields[3,4]. Schiff base is a nitrogen analogue of aldehyde or ketone in which C=O is replaced by a C=N–R group. It is usually formed by the condensation of an aldehyde or ketone with a primary amine. Schiff bases bearing the aryl substituents are sustainably more stable and readily formed due to conjugation compared to the alkyl groups which are relatively unstable and polymerizable. Schiff bases are some of the most widely used organic compounds. They are used as pigments and dyes, catalysts, intermediates in organic synthesis and as polymer stabilizers[5]. Schiff bases have also been shown to exhibit a broad range of biological activities, including antifungal[6], antibacterial[7], antimalarial[8], antitubercular[9], antiviral[10], anti proliferative, anti-inflammatory and antipyretic properties[11]. In view of these biological importance of schiff bases a series of 1-benzylidene-2-[1-(naphthalene-2yl) ethylidene] hydrazine derivatives from naphthalene were prepared by conventional methods in our laboratory and few of the compounds had showed promising antibacterial activity. Further in continuation of our work[12] on the synthesis of Schiff bases from 2-acetylnaphthalene and to involve the concept of green chemistry in organic synthesis, in the present study microwave irradiation (scheme I) was used to synthesize these conventionally prepared compounds.

MATERIALS AND METHODS

Melting points were determined by open capillary and are uncorrected. The purity of the compounds was checked using pre coated (MERCK 60, F) TLC plates using solvent n-Hexane: ethyl acetate (6:4) as mobile phase. The plates were visualized under UV light at 254 nm, IR spectra were recorded using KBr Schimadzu FTIR model 8400 Spectrophotometer, ^{1}HNMR spectra was performed in $CDCl_3$ on a BRUKER FT-NMR instrument using TMS as internal standard.

Synthesis of 1-{1-(naphthalene-2-yl)ethylidene}hydrazine from 2-acetylnaphthalene

0.1 mol (17.1 g) of 2- acetylnaphthalene was dissolved in 20 ml of ethanol in a 250 ml conical flask. To this mixture 0.1 mol (4.9 ml) of hydrazine hydrate (99 %) was added drop wise with shaking and 4-5 drops of glacial acetic acid was also added, kept in a microwave oven for a duration of 3-5 minutes at 450 W, the reaction progress have been monitored by TLC using n-hexane: ethylacetate (6:4) as a solvent. The reaction mixture was cooled and poured into ice cold water. Thus, the solid obtained was collected through suction, and again washed with 5 % $NaHCO_3$ solution, dried and re crystallized from ethanol. R_f value: (0.86); m.p: (116-118^{o}C); IR (KBr cm^{-1}): [1589 (C=N), 3375, 3227(NH- str) 2920 (CH stretch), 1371 (CH bend), 1496(C=C Ar), 854 (CH- Ar)].

Synthesis of 1-benzylidene-2-[1-(naphthalene-2-yl) ethylidene] hydrazine derivatives (1a to 1h)

Equimolar quantities of 1-[(naphthalen-2-yl)ethylidene]hydrazine (0.01 mol 1.84 g) and various substituted benzaldehydes (0.01 mol) were dissolved in 20 ml of ethanol, 4-5 drops of glacial acetic acid was added, kept in a microwave oven for a duration of 3-5 minutes at 450 W, the reaction progress have been monitored by TLC using n-hexane: ethylacetate (6:4) as a solvent. The reaction mixture was cooled; yellow crystals were formed in the solution and were collected through suction, washed with ethanol and 5 % $NaHCO_3$ solution respectively, dried and re crystallized from ethanol. The compounds were characterized by physical constants (m.p, R_f) Table 1 and Spectral data {IR (KBr, cm^{-1}), ^{1}HNMR (δ ppm)} Table 2.

Scheme I: Microwave assisted synthesis of Schiff bases

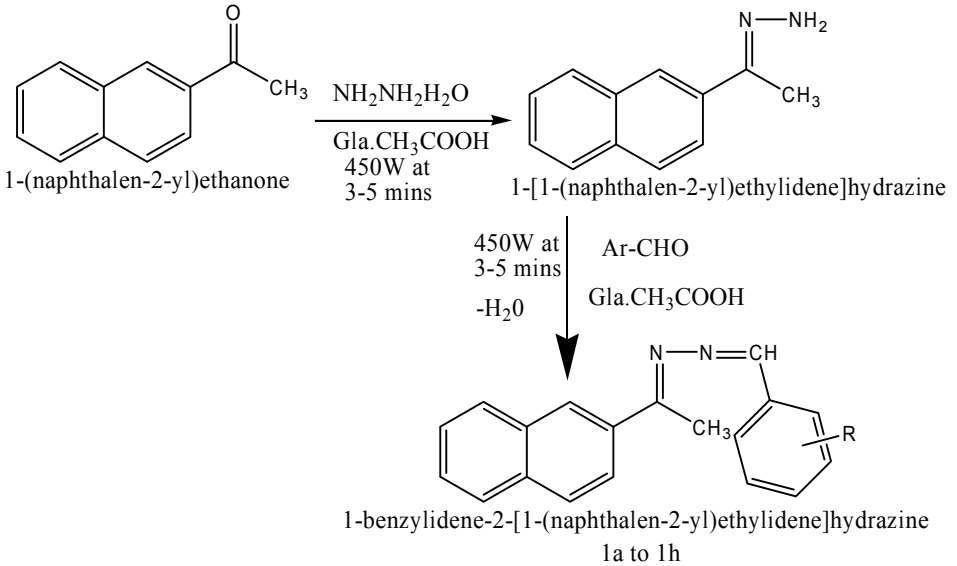

Table 1: Physical Data of Compounds 1a to 1h

Compound	R	Molecular Formula	Mol. Wt	Conventional			Microwave			R_f value
				Reaction time (h)	% Yield	m.p (^oC)	Reaction time (min)	% Yield	m.p (^oC)	
1a	4-$N(CH_3)_2$	$C_{21}H_{21}N_3$	315	5.0	60.50	178-181	3	82.50	180-181	0.79
1b	4-OH	$C_{19}H_{16}N_2O$	288	6.0	55.70	190-193	3	80.00	191-193	0.60
1c	4-Cl	$C_{19}H_{15}N_2Cl$	306	6.0	56.70	185-188	5	88.90	187-188	0.78
1d	NO_2	$C_{19}H_{15}N_3O$	317	5.0	54.50	135-138	5	81.50	137-138	0.75
1e	4-F	$C_{19}H_{15}N_2F$	290	5.5	53.60	158-161	5	85.20	159-161	0.79
1f	2-OH	$C_{19}H_{16}N_2O$	288	5.5	52.70	151-154	3	77.60	153-154	0.68
1g	OCH_3	$C_{20}H_{18}N_2O$	302	5.0	54.90	155-158	5	78.40	157-158	0.78
1h	3,4,5-OCH_3	$C_{22}H_{22}N_2O_3$	362	6.0	55.80	141-145	5	79.50	144-145	0.35

Table 2: Spectral data of Compounds 1a to 1h

Compound	IR values (KBr, cm^{-1})	^{1}HNMR (δ ppm)
1a	1600.97(C=N), 1521.89 (C=C Ar), 1361.79(CH bend)	δ 2.3(s, 3H, C-CH_3), 2.84[m, 6H, $N(CH_3)_2$], 6.8-8.3(m, 11H,Ar-H), 8.1(s, 1H, -N=CH)
1b	1600.97(C=N), 3249.53(OH), 1512.24(C=C Ar).	δ 2.3(s, 3H, C-CH_3), 5.1(s, 1H, Ar-OH), 6.7-8.3(m, 11H,Ar-H), 8.1(s, 1H, -N=CH)
1c	1610.61(C=N), 748.41(Cl), 1481.38 (C=C Ar)	δ2.4(s, 3H, C-CH_3) 6.9-8.4(m, 11H,Ar-H), 8.1(s, 1H, -N=CH)
1d	1597.11(C=N), 1342.50(NO_2), 1523.82(C=C Ar).	δ 2.4(s, 3H, C-CH_3), 6.8-8.5(m, 11H,Ar-H), 8.1(s, 1H, -N=CH)
1e	1597.11(C=N), 1226.77(F), 1520.60(C=C Ar).	δ 2.3(s, 3H, C-CH_3),6.8-8.3(m, 11H,Ar-H), 8.1(s, 1H, -N=CH)
1f	1610.61(C=N), 1491.02(C=C Ar)	δ 2.3(s, 3H, C-CH_3), 5.0 (s, 1H, Ar-OH), 6.7-8.3(m, 11H,Ar-H), 8.1(s, 1H, -N=CH)
1g	1600.97(C=N), 1504.53(C=C Ar)	δ 2.64(s, 3H, C-CH_3), 3.85(s, 3H, Ar-OCH_3), 6.8-8.3(m, 11H,Ar-H), 8.1(s, 1H, -N=CH).
1h	1577.82(C=N), 1504.83(C=C Ar)	δ 2.64(s, 3H, C-CH_3), 3.64-3.9(m, 9H, Ar-OCH_3), 6.8-8.3(m, 11H,Ar-H), 8.1(s, 1H, -N=CH).

RESULTS AND DISCUSSION

Among many requirements for a drug discovery process, one of the essential requirements from the medicinal chemist point of view is the high throughput synthetic method for the production of libraries of compound in a short period of time. In this attempt we have used microwaves to generate the series of Schiff bases (1a to 1h). We observed many advantages compared to the conventional method of synthesizing these organic compounds in terms of reaction times, yield, solvent minimization and its inherent simplicity. The use of microwave irradiation facilitates the polarization of the molecules under the irradiation causing rapid reaction to occur. IR absorptions at 1577.82 to 1610.61 cm^{-1} in all compounds 1a to 1h, indicates the formation of C=N linkage between substituted aromatic benzaldehydes and hydrazine used. This is further confirmed by the appearance of a singlet in ^{1}H NMR at δ 8.1 ppm corresponds to a hydrogen atom in N=CH. In summary, microwave assisted synthesis of Schiff bases were carried out to get the higher yield (77.60 - 88.90 %) with less reaction time (3-5 minutes) compared to the conventional method 5-6 h and it can be concluded that microwave method plays a vital role in green chemistry.

ACKNOWLEDGEMENTS

We express our gratitude to the Principal Dr. S. Shashidhara, Government College of Pharmacy, Bangalore, India for providing the facilities to carry out the experiments. We would also like to thank American Association of Government College of Pharmacy Alumni for their financial support and

NMR Research Centre, IISC Bangalore, India for providing the spectral data on time.

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Cite this article as:
Enamul Hassain S, Chaluvaraju KC, Niranjan MS, Zaranappa, Santhosh C. Studies on microwave assisted synthesis of some Schiff bases. Int. Res. J. Pharm. 2013; 4(11):99-101 http://dx.doi.org/10.7897/2230-8407.041122

Source of support: Nil, Conflict of interest: None Declared