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Microwave Assisted Synthesis of Some 2-Alkyl and 2-Arylperimidines

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Perimidine derivatives, **3(a–m)**, were synthesized in high yield (65–80%) using a microwave assisted cyclocondensation reaction of 1,8-diaminonaphthalene and carboxylic acid under acidic condition. Products were recrystallized from water or a mixture of water and ethanol. The synthesis of perimidine derivatives under microwave irradiation results in high yield and requires shorter time than by conventional heating method.

Key Words: Diaminonaphthalene, Perimidine, Microwave.

INTRODUCTION

Perimidines are of wide interest because of their diverse biological activities and chemical applications[1–3]. Several classical synthetic methods have been reported for the synthesis of perimidine derivatives[4–6]. The most widely used method for preparation of perimidines is the cyclocondensation reaction of 1,8-diaminonaphtalene with carboxylic acids under reflux condition. Most aliphatic carboxylic acids enter the process easily; however, more vigorous conditions are necessary for aryl carboxylic acids.

Microwave irradiation is a non-conventional energy source, which has been of special interest in organic chemistry in recent years[7–11]. Some of the interesting features of this method are the rapid reaction rates, simplicity and cleaner reaction conditions[11–14].

In order to synthesize some perimidine derivatives by a clean and fast method, the influence of microwave irradiation on acid-catalyzed cyclization of 1,8-diaminonaphthalene with different carboxylic acids has been investigated.

EXPERIMENTAL

All chemicals including 1,8-diaminonaphthalene, carboxylic acids were of reagent grade quality and used without further purification. ^{1}H NMR spectra were recorded on a Brucker 500 MHz spectrometer. IR spectra were performed on a Galaxy FT-IR 500 spectrophotometer. The progress of the reaction was routinely monitored by thin layer chromatography (TLC) on silica gel plates. Reactions were performed in a Samsung microwave oven with a 230 V–50 Hz power source, 900 W output and 2450 MHz operating frequency. Compounds **3(a–h)**

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were characterized by comparison of their spectra (IR, ^{1}H NMR) with those of authentic samples, which were prepared under reflux. Compounds **3(i–m)** were also characterized by IR and ^{1}H NMR spectroscopy.

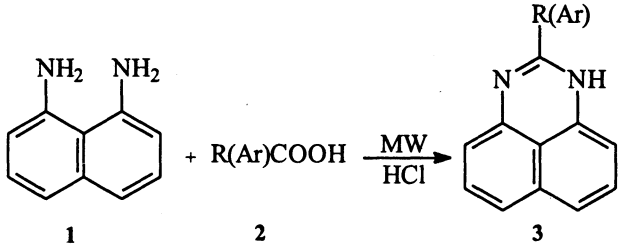
General procedure for preparation of 2-alkyl and 2-arylperimidines

For preparation of 2-alkylperimidines, **3(a–h),** 1,8-diaminonaphthalene (1.0 mmol) was ground in a pestle and mortar with an appropriate carboxylic acid (1.0 and 0.5 mmol for monofunctional and bifunctional acid respectively). The mixture was placed in a 25 mL glass beaker and two drops of HCl (4 M) added. This beaker was put into a microwave oven and subjected to microwave irradiation at 100% power level for 1 to 2 min depending on used carboxylic acid. The beaker then was kept at room temperature for 2 h and the crude products were recrystallized from a mixture of ethanol and water (50 : 50) to give compounds **3(a–h).** Also for separation of these compounds using conventional heating method, a solution of 1,8-diaminonaphthalene (1 mmol) and equimolar amount of appropriate carboxylic acid in 10 mL HCl (4 M) was refluxed for 5–6 h. The cooled solution was neutralized with NaOH (0.1 M) and the precipitated product was filtered and recrystallized from a mixture of ethanol and water.

For preparation of 2-arylperimidines **3(i–m),** a mixture of 1,8-diaminonaphthalene (1 mmol) and aryl acid (1.5 mmol) were ground together with 2 mL ethanol and 2 drops of HCl (4 M). The mixture was irradiated in the microwave oven 3 times at the 50% power level for 30 s with a 1 min and 2 min cooling period after the first and second irradiation cycle, respectively. After addition of water (10 mL) the solution was neutralized with dilute NaOH (0.1 M) and kept at room temperature to give the crude product. The crude product was recrystallized from ethanol.

RESULTS AND DISCUSSION

Perimidines **3(a–m)** were prepared by acid-catalyzed cyclization of 1,8-diaminonaphthalene, **1,** with apropriate carboxylic acid, **2,** under microwave irradiation **(Scheme-1).**



1 **2** **3**

(3a) R = Methyl
(3b) R = Ethyl
(3c) R = Chloromethyl
(3d) R = Trichloromethyl
(3e) R = yl-Methanethiol
(3f) R = 2-(1H-perimidine-2-yl)ethyl
(3g) R = 4-(1H-perimidine-2-yl)butyl
(3h) R = (Z)-2(1H-perimidine-2-yl)-1-ethenyl
(3i) Ar = 2-hydroxyphenyl
(3j) Ar = 2-chlorophenyl
(3k) Ar = 3-chlorophenyl
(3l) Ar = 2-pyridil
(3m) A = 3-pyridil

Scheme-1

For preparation of 2-arylperimidines, it is worth noting that 2 mL of ethanol has to be added to the reaction mixtures in order to facilitate the conversion of microwave energy into thermal energy. The method is easy and can be used for the synthesis of different perimidines **3(a–m)** depending on R or Ar groups of carboxylic acids (Table-1). Yields of these reactions following recrystallization were of the order of 65–80%, which is very favourable as compared with conventional heating method (Table-1).

TABLE-1
COMPARISON OF TIME AND YIELDS ON THE FORMATION OF SOME PERIMIDINES USING MICROWAVE IRRADIATION AND CONVENTIONAL HEATING

Compd. No.	Used carboxylic acid	Microwave irradiation		Conventional heating		
		t/min	Yield (%)	t/min	Yield (%)	t_c/t_{mv}
3a	Acetic acid	1.5	75	300	65	200
3b	Propionic acid	1.5	70	300	60	200
3c	Chloroacetic acid	1.5	80	330	65	220
3d	Trichloroacetic acid	2.0	80	300	65	150
3e	Thioglycolic acid	1.0	75	300	60	300
3f	Succinic acid	1.5	65	360	60	360
3g	Adipic acid	1.0	65	300	60	300
3h	Maleic acid	1.5	75	300	70	200
3i	2-Chlorobenzoic acid	1.5	70	300	—	—
3j	3-Chlorobenzoic acid	1.5	77	300	—	—
3k	2-Pyridine carboxylic acid	1.5	70	300	—	—
3l	3-Pyridine carboxylic acid	1.5	74	300		
3m	2-Hydroxyphenyl	1.5	79	300	—	—

Table-1 compares the synthetic conditions of different perimidines under microwave irradiation and conventional heating. Synthesis of perimidines from carboxylic acids, especially aryl carboxylic acids and 1,8-diaminonaphthalene using conventional heating needs vigorous reaction conditions. In this matter, preparation of arylperimidines **3(i–m),** from acid-catalyzed reaction of 1,8-diaminonaphthalene with aromatic carboxylic acids under reflux and forced conditions was not successful. Several authors have reported such different vigorous conditions for similar reactions between *o*-phenylendiamine and aryl or sterically hindered aliphatic carboxylic acids[15]. However, microwave irradiation promotes these reactions easily so that the reaction times are reduced to minutes rather than hours for conventional heating method. The ratio between the reaction times (t_c/t_{mv} = 150–300) using conventional heating and microwave irradiation reflects the microwave heating effect.

In conclusion, the rapid heating induced by microwave irradiation not only avoids the force conditions and the decomposition of the reagents but also results in the formation of clean product under mild conditions, thus increasing the yield. As a result synthesis of perimidines **3(a–m)** under microwave irradiation is more convenient and much faster than conventional heating.

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