Med Chem Res (2012) 21:1692–1699
DOI 10.1007/s00044-011-9687-0

MEDICINAL CHEMISTRY RESEARCH

ORIGINAL RESEARCH

Synthesis and pharmacological properties of some novel pyrazolidine and pyrazole derivatives

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Received: 11 October 2010 / Accepted: 26 May 2011 / Published online: 9 June 2011

Abstract Microwave synthesis technique opens new avenues for the synthesis of many compounds. A novel and simple method has been developed for the synthesis of 1-(2,4-dinitrophenyl) pyrazolidine-3,5-dione and 1-(2,4-dinitrophenyl)-3,5-dimethyl-1H-pyrazole derivatives under microwave irradiation. These compounds exhibit mild to moderate antimircrobial activity against different strains of bacteria (e.g. *E. coli, P. aeruginosa*, *S. aureus* and *B subtilis*) and fungi (e.g. *C. albicans* and *A. niger)*. All these synthesised compounds have been characterised by employing various techniques like TLC, Elemental analysis, IR, NMR and MS spectra. In addition to this, the yields of these compounds have been compared with the same compounds, obtained by conventional heating procedures. And the results show that by microwave irradiation method, the product yield is either high or may be same but it takes a very short period of time for reaction. Moreover, this technique provides ecofriendly or green chemical pathway for the synthesis of these compounds. Thus, the microwave irradiation method is more useful than the conventional method because of the shorter reaction time, better yield, conservation of energy and ecofriendly nature.

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Keywords Synthesis · Microwave irradiation · Conventional heating · Isonicotinohydrazide · Ethyl 2-cyanoacetate · Hexane-2 · 4-Dione · Pyrazolidine and pyrazole

Introduction

Pyrazoline consist a unique class of five-member ring. Pyrazoline (Kumar *et al.*, 2009) shows various biological and pharmacological activities such as antimicrobial, (Venkataraman *et al.*, 2010) and (Parashar *et al.*, 2010a, b), anti-inflammatory (Amir *et al.*, 2008) and (Rathish *et al.*, 2009), antitumor (Stirrett *et al.*, 2008), antidepressant (Prasad *et al.*, 2005), antamoebic (Abid *et al.*, 2007), insecticides (Silver and Soderlund, 2005) activities. Whereas some of these show antidiabetic (Ahn *et al.*, 2004), analgesic (Karabasanagouda *et al.*, 2009), anticancer (Ozdemir and Asim, 2008) and antiepileptic (Kelekci *et al.*, 2008), activities. The chemistry and antimicrobial activity of some substituted pyrazolines have been investigated in recent years (Parshar *et al.*, 2010a, b) and it was thought world while to synthesis the some new pyrazolines compounds (Revanasiddappa *et al.*, 2010) from easily available starting materials and evaluations of its possible antimicrobial and anti-inflammatory activity.

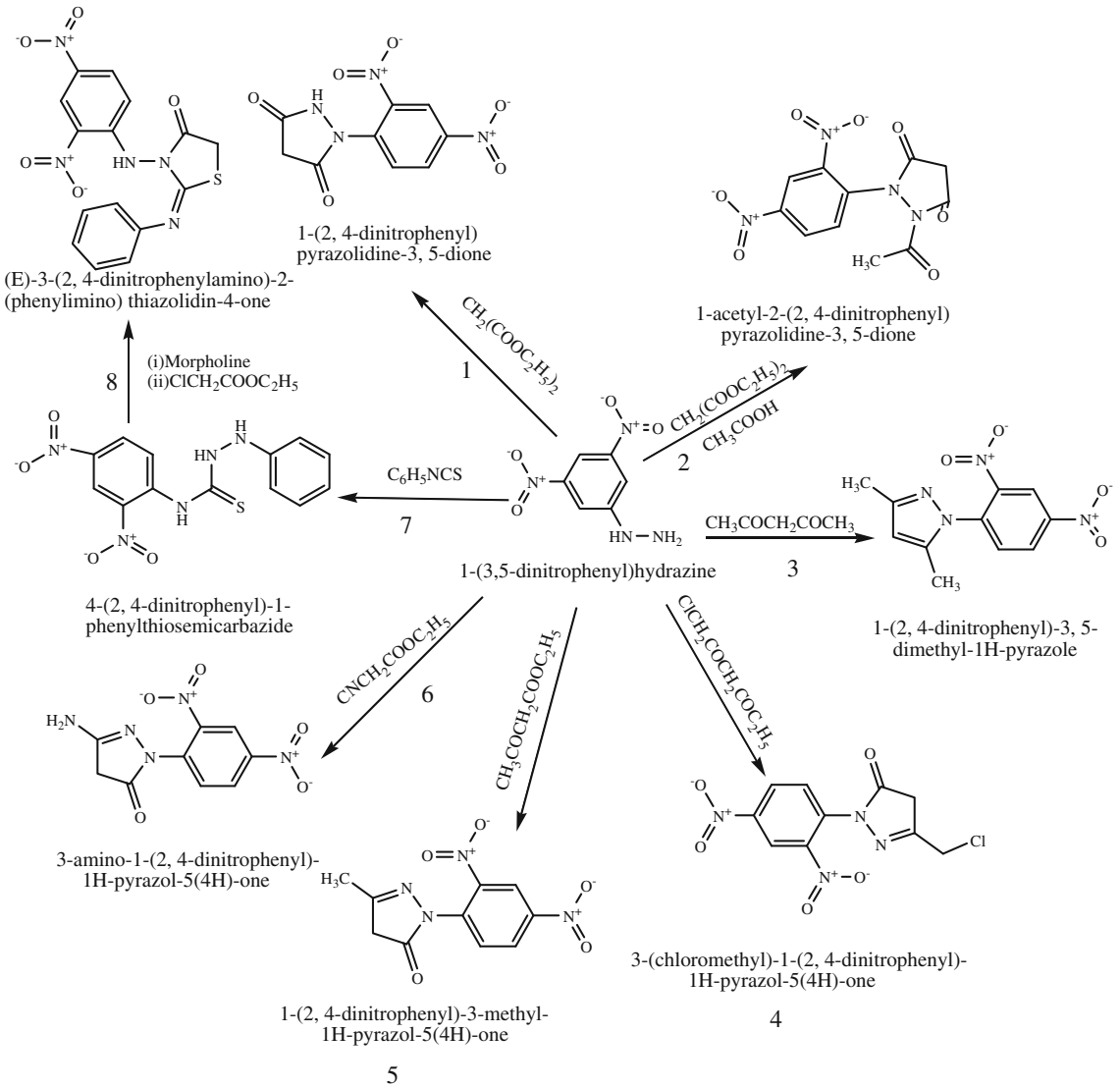
The microwave irradiations technique is employed for carrying out chemical transformations, which are ecofriendly. The basis of this synthesis techniques is the empirical observation that some organic reactions proceed much faster and with higher yields under microwave irradiation compared to conventional heating (Chawla *et al.*, 2010) and (Parashar *et al.*, 2010a, b). Most of the organic reactions have been heated using traditional heat transfer equipments such as oil baths, sand baths or heating

mentales. These techniques are rather slow and create temperature gradients within the sample.

Synthesis of some new pyrazolines derivatives using diethylmalonate, acetyl acetate, 1-chlorohexane-2-4-dione, ethyl acetate, ethylcynoacetate by conventional and microwave-assisted methods have been done. The reaction carried out in absolute alcohol or DMF using conventional method required about 4–12 h, while microwave irradiation method required only 2 to 3.30 min. In conventional method, the yields are lower as compared to microwave irradiation. It should be mentioned here that the effect of microwave irradiation is not purely thermal; microwave irritation facilitates the polarisation of the molecules under irradiation causing rapid reaction to occur. The synthetic route of above mentioned compound is shown in Scheme 1.

Experimental

All the reactions were carried out in a domestic microwave oven (Kenstar, model no. OM 26.EGO). Melting points of synthesis compounds were determined in open capillaries in liquid paraffin are uncorrected. Purity of the compounds in addition to elemental analysis were verified by percolated TLC using silica gel G as a adsorbent using ethyl acetate: *n*-hexane (7:3) as a eluent and spot was detected by using iodine vapours. The IR (KBr pellets) spectra were recorded on a Perkin Elimer-1800-spectrophotometer and ^{1}H NMR spectra were recorded on BRUKER DRX-300 MHz spectrophotometer, (TMS as a internal reference) and chemical shifts are expressed in δ. Mass spectra were recorded on Jeol D30 spectrophotometer. Elemental analyses for C, H and N were conducted using a Perkin-Elmer



Scheme 1 The synthetic route of compounds (**1–8**)

C, H, and N analyzer. The results were found to be an in good agreement with the calculated values (±0.4%).

Synthesis of 1-(2,4-dinitrophenyl) pyrazolidine-3,5-dione (**1**)

Conventional method

To a solution of 1.00 g of 1-(3, 5-dinitrophenyl) hydrazine (0.005 mol), in 50 ml of absolute ethanol, 5 ml acetic acid and 0.80 g of diethyl malonate (0.005 mol), were added in a round bottom flask. The mixture was well stirred and refluxed for about 12–14 h. The reaction was monitored by TLC. When the reaction was complete, the reaction mixture was cooled at room temperature and poured into a beaker containing crushed ice. Solid was separated and recrystallized from ethanol.

Microwave method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol), 5 ml acetic acid and 0.80 g of diethyl malonate (0.005 mol) were taken in an Erlenmeyer flask and stirred. Then this well-stirred mixture was irradiated in microwave oven for 3 min at 480 W (i.e., 40% microwave power). The completion of the reaction was monitored by TLC. The brown coloured oily mass obtained was cooled and the crude product was recrystallized from ethanol to give compound **1**. Spectral and analytical data were found to be similar for compounds obtained by conventional and microwave methods. The physical data and R_f value are reported in Table 1.

Elemental analysis (found)

C, 40.35; H, 2.54; N, 20.70; (Calculated): C, 40.61 H, 2.27; N, 21.05, Mol. Formula: $C_9H_6N_4O_6$; IR (cm^{-1}): 3303 (–NH), 1660, 1640 (C=O), 1525 ($–NO_2$), 1230 (N–N); ^{1}HNMR (δ, ppm DMSO-d_6)**:** 7.20, 8.50, 9.00 (m, 3H, Ar–H), 8.70 (s, H, NH), 3.45–3.40 (2H, d, CH_2 of pyrazoline); MS: *m/z* $[M]^+$ 266.

Synthesis of 1-acetyl-2-(2,4-dinitrophenyl) pyrazolidine-3,5-dione (**2**)

Conventional method

To a solution of 1.00 g of 1-(3, 5-dinitrophenyl) hydrazine (0.005 mol), in 20 ml acetic acid, 0.80 g of diethyl malonate (0.005 mol) was added in a round bottom flask. Then the well-stirred mixture was refluxed for 11–12 h. The completion of the reaction was monitored by TLC. The reaction mixture was then cooled at room temperatures and poured into crushed ice. The solid obtained was filtered, washed with water, and recrystallized from ethanol to give product **2**.

Microwave method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol), 10 ml acetic acid, 0.80 g of diethyl malonate (0.005 mol) were taken in Erlenmeyer flask. Then the well-stirred mixture was irradiated in microwave oven for 3.00 min at 480 W (i.e., 40% microwave power). The completion of the reaction was monitored by TLC. The solid reaction mixture was cooled and poured into a beaker containing crushed ice. The solid obtained was recrystallized from ethanol to give product **2**. Spectral and analytical data were found to similar as reported for conventional method. The physical data and R_f values are recorded in Table 1. Spectral and analytical data were found to similar as reported for conventional method.

Elemental analysis (found)

C, 42.35; H, 2.44; N, 18.38; (Calculated): C, 42.87 H, 2.62; N, 18.18, Mol. Formula: $C_{11}H_8N_4O_7$; IR (cm^{-1}): 1710, 1668, 1650 (C=O), 1538 ($–NO_2$) 1230 (N–N); ^{1}HNMR

Table 1 The physical data and R_f value of the synthesised compounds (**1–8**)

Com.	Condition	Molecular formula	M. wt	Convention method		Microwave method		m.p. °C ± 2	R_f
				Yield%	R time (h)	Yield %	R time (min)		
1	Acetic acid	$C_9H_6N_4O_6$	266	48	12–14	82	3.00	185	0.53
2	–	$C_{11}H_8N_4O_7$	308	52	11–12	88	3.00	205	0.55
3		$C_{11}H_{10}N_4O_4$	262	51	15–16	88	3.30	168	0.54
4		$C_{10}H_7ClN_4O_5$	298	57	12–14	86	3.30	222	0.58
5	Acetic acid	$C_{10}H_8N_4O_5$	264	55	10–11	87	3.00	167	0.54
6		$C_9H_7N_5O_5$	265	49	10–11	88	2.00	188	0.51
7		$C_{13}H_{11}N_5O_4S$	333	52	14–15	75	3.00	238	0.53
8	Morpholine	$C_{15}H_{11}N_5O_5S$	373	46	16–17	84	2.30	268	0.61

(δ, ppm DMSO-d_6)**:** 7.22, 8.40, 8.98 (m, 3H, Ar–H), 3.40–3.32 (2H, d, CH_2 of pyrazoline,); 2.40 (s, 3H, CH_3); MS: *m/z* $[M]^+$ 308.

Synthesis of 1-(2,4-dinitrophenyl)-3,5-dimethyl-1H-pyrazole (**3**)

Conventional method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) and acetyl acetone (0.50 g, 0.005 mol) in absolute alcohol (20.0 ml) was warmed on a water bath for 15–16 h with stirring. The completion of the reaction was monitored by TLC. The reaction mixture was cooled at room temperature and treated with ice-cold water. The solid product obtained was filtered off, washed with water and recrystallized from methanol to give product **3**.

Microwave method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) and acetyl acetone (0.50 g, 0.005 mol) were taken in Erlenmeyer flask. The mixture was well stirred and irradiated in microwave oven for a period 3.30 min at 480 W (i.e., 40% microwave power) with intermitted irradiation for 30 s interval. The reaction mixture was then allowed to stand at room temperatures. The solid product obtained was filtered off, washed with water and dissolved in methanol then filtered, dried and recrystallized from ethanol to afford compound **3**. The physical data and R_f value are recorded in Table 1. Spectral and analytical data were found to similar as reported for conventional method.

Elemental analysis (found)

C, 50.66; H, 3.51; N, 21.08; (Calculated): C, 50.38; H, 3.84; N, 21.37; Mol. Formula: $C_{11}H_{10}N_4O_4$; IR (cm^{-1}):, 1553 (C=N), 1530 (-NO_2) 1234 (N–N); ^{1}H NMR (δ, ppm DMSO-d_6)**:** 7.82, 8.60, 9.10 (m, 3H, Ar–H), 6.20 (s, 1H, CH), 2.20 (s, 3H, CH_3) 2.30 (s, 3H, CH_3); MS: *m/z* $[M]^+$ 262.

Synthesis of 3-(chloromethyl)-1-(2,4-dinitrophenyl)-1H-pyrazol-5(4H)-one (**4**)

Conventional method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) and 1-chloro-hexane 2-4-dione (0.80 g, 0.005 mol) was taken in absolute alcohol (25.00 ml). The mixture was well stirred and refluxed for 12–14 h. Then the reaction mixture was kept overnight and the solution was poured into ice-cold water. The resulting solid compound was filtered, dried, and recrystallized from alcohol to give **4**.

Microwave method

Mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) and 1-chloro-hexane 2-4-dione (0.80 g, 0.005 mol) was taken in an Erlenmeyer flask and stirred vigorously. The well-stirred mixture was irradiated in microwave oven for 3.30 min at 480 W (i.e., 40% microwave power) with intermitted irradiation for 30 s interval. The reaction was monitored by TLC and after completion of the reaction; the contents were poured onto the crushed ice. The solid obtained was filtered off, washed with cold water, and purified by recrystallization from ethanol to get product **4**. The physical data and R_f value are reported in Table 1. Spectral and analytical data were found to similar as reported for conventional method.

Elemental analysis (found)

C, 40.24; H, 2.59; N, 18.58; (Calculated): C, 40.42; H, 2.36; N, 18.76; Mol. Formula: $C_{10}H_7ClN_4O_5$; IR (cm^{-1}): 1666 (C=O), 1606 (C=N), 1239 (N–N); ^{1}H NMR (δ, ppm DMSO-d_6): 8.12, 8.56, 9.08 (m, 3H, Ar–H), 3.34–3.26 (2H, d, CH_2 of pyrazoline,) 2.30 (s, 2H, CH_2); MS: *m/z* $[M]^+$ 298.

Synthesis of 1-(2,4-dinitrophenyl)-3-methyl-1H-pyrazol-5(4H)-one (**5**)

Conventional method

To a solution of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) in 25.00 ml of absolute ethanol, 5.00 mL acetic acid and hexane-2,4-dione (0.55 g, 0.005 mol) was added in a round bottom flask. The mixture was well stirred and refluxed for about 12–14 h. The reaction was monitored by TLC and after completion of the reaction; the contents were poured onto the crushed ice. The solid obtained was filtered off, washed with cold water and purified by recrystallization from ethanol to get product **5**. The physical data and R_f value are reported in Table 1. Spectral and analytical data were found to similar as reported for conventional method.

Microwave method

To a solution of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) in 25.00 ml of absolute ethanol, 5.00 ml acetic acid and hexane-2,4-dione (0.55 g, 0.005 mol) was taken in an Erlenmeyer flask and stirred vigorously. The mixture was then irradiated under microwave oven for 3.00 min at

480 W (i.e. 40% microwave power) with intermitted irradiation for 30 s interval. Upon completion of the reaction (monitored by TLC), the reaction mixture was poured onto the crushed ice. The solid mass obtained was filtered and washed several times with water. Purification by recrystallization with alcohol gave product **5**. The physical data and R_f values are reported in Table 1. Spectral and analytical data were found to similar as reported for conventional method.

Elemental analysis (found)

C, 45.14; H, 2.75; N, 21.42; (Calculated): C, 45.46; H, 3.05; N, 21.21; Mol. Formula: $C_{10}H_8N_4O_5$; IR (cm^{-1}): 1660 (C=O), 1520 (C=N), 1301 (N=N); ^{1}H NMR(δ, ppm DMSO-d_6): 7.80, 810, 8.60 (m, 4H, Ar–H),), 3.41–3.34 (2H, d, CH_2 of pyrazoline,) MS: *m/z* $[M]^+$ 264.

Synthesis of 3-amino-1-(2,4-dinitrophenyl)-1H-pyrazol-5(4H)-one (**6**)

Conventional method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) and ethyl 2-cyanoacetate (0.60 g, 0.005 mol) was taken 20.0 ml of DMF and the mixture was refluxed for 10–11 h. The progress of the reaction was monitored by the TLC. The reaction mixture was allowed to attain the room temperature. The mixture was then poured into the ice-cold water. The resulting solid product **6** was filtered, dried, and recrystallized from methanol.

Microwave method

A mixture of 1.00 g of 1-(3,5-dinitrophenyl) hydrazine (0.005 mol) and ethyl 2-cyanoacetate (0.60 g, 0.005 mol) was taken in an Erlenmeyer flask and mixed thoroughly. The mixture was irradiated under microwave for 2.00 min at 600 W (i.e., 50% microwave power) power with intermittent radiation of 30 s interval. The progress of the reaction was monitored by the TLC. The mixture was then poured into the ice-cold water, filtered, dried, and recrystallized from methanol to give product **6**. The physical data and R_f values are reported in Table 1. Spectral and analytical data were found to similar as reported for conventional method.

Elemental analysis (found)

C, 40.52; H, 2.80; N, 26.72; (Calculated): C, 40.76; H, 2.66; N, 26.41, Mol. Formula: $C_9H_7N_5O_5$; IR (cm^{-1}): 3334, 3218 (–NH_2), 1670 (C=O), 1554 (C=N), 1311 (N=N); ^{1}HNMR (δ, ppm DMSO-d_6): 8.02, 8.16, 8.40 (m, 3H, Ar–H); 5.10 (s, 2H, NH_2), 3.51–3.44 (2H, d, CH_2 of pyrazoline); MS: *m/z* $[M]^+$ 265.

Synthesis of 4-(2,4-dinitrophenyl)-1-phenylthiosemicarbazide (**7**)

Conventional method

A mixture of 1-(3,5-dinitrophenyl) hydrazine (1.00 g, 0.005 mol) and phenyl isothiocynate (0.70 g, 0.005 mol) was dissolved in 20 ml of DMF in a round bottom flask. Then the well-stirred mixture was refluxed 14–15 h. The TLC monitored the completion of the reaction. The reaction mixture was then allowed to stand at room temperature, after that the mixture was poured in ice-cold water. The resulting solid was filtered, dried, and recrystallized from benzene.

Microwave method

A mixture of 1-(3,5-dinitrophenyl) hydrazine (1.00 g, 0.005 mol), phenyl isothiocynate (0.70 g, 0.005 mol) and 20 ml DMF was taken in Erlenmeyer flask. The mixture was irradiated under microwave for 3.00 min at 400 W powers with intermittent radiation of 15 s interval. TLC examined the progress of the reaction. The mixture was poured into ice-cold water. The resulting solid was filtered, dried, and recrystallized from benzene to give product **7**. The physical data and R_f value are recorded in Table 1. Spectral and analytical data were found to be similar for compounds obtained by both reported methods for conventional and microwave methods.

Elemental analysis (found)

C, 57.55; H, 4.24; N, 20.70, S; 9.40 (Calculated): C, 46.84; H, 3.33; N, 21.01, S, 9.62; Mol. Formula: $C_{13}H_{11}N_5O_4S$; IR (cm^{-1}): 3410, 3362, 3342 (–NH), 1530 (–NO_2), 1110 (C=S), ^{1}H NMR (δ, ppm DMSO-d_6): 6.66–7.10. (m, 5H, Ar–H) 6.98, 8.23, 8.60 (m, 3H, Ar–H), 3.64 (s, H, HN–Ph), 3.84 (s, H, HN–dinitrophenyl hydrazine), 2.20 (s, H, HN–N); MS: *m/z* $[M]^+$ 333.

Synthesis of (E)-3-(2,4-dinitrophenylamino)-2-(phenylimino) thiazolidin-4-one (**8**)

Conventional method

A mixture of compound **7** (1.00 g, 0.003 mol), ethylchloroacetate (0.40 g, 0.003 mol) and 2-3 drops of morpholine was taken in a round bottom flask and dissolved in 25 mL ethanol. After then reaction mixture was refluxed for 16–17 h. The TLC monitored the progress of the reaction.

The reaction mixture was allowed to attain the room temperature. After that the mixture was poured into the ice-cold water. The resulting solid product **8** was filtered, dried, and recrystallized from methanol.

Microwave method

A mixture of **7** (1.00 g, 0.003 mol), ethylchloroacetate (0.40 g, 0.003 mol) and in presence of catalytic amount of morpholine were taken in Erlenmeyer flask and mixed thoroughly. Then the mixture was irradiated under microwave oven for 2.30 min at 480 W (i.e. 40% microwave power) with an intermitted irradiation for 30 s interval. The TLC monitored the progress of the reaction. The product was cooled and poured into ice-cold water and recrystallized from ethanol to give product **8**. The physical data and R_f value are recorded in Table 1. Spectral and analytical data were found to be similar for compounds obtained by both reported methods for conventional and microwave methods.

Elemental analysis (found)

C, 57.35; H, 4.14; N, 18.20, S, 8.28; (Calculated): C, 48.26; H, 2.97; N, 18.76 S, 8.59; Mol. Formula: $C_{15}H_{11}N_5O_5S$; IR (cm^{-1}): 3362 (–NH), 1649 (C=O), 1554 (C=N), 1235 (N–N) 742 (C–S–C); ^{1}H NMR (δ, ppm DMSO-d_6): 9.60 (s, H, HN) 7.6–7.8 (m, 5H, Ar–H), 7.18, 8.43, 8.68 (m, 3H, Ar–H), 4.10 (s, 2H, CH_2) MS: *m/z* $[M]^+$ 373.

Antimicrobial activity

All the synthesis compounds **1**–**8** have been screened for In vitro antimicrobial study. It was carried out on Muller Hinton agar (Hi-media) plates (37°C, 24 h) by agar diffusion cup plate method (Kelekci *et al.*, 2008). These were screened for antimicrobial activity at 200, 100 and 50 µg/ml concentration against the bacterial strains: *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas eruginosa*, and *Staphylococcous aureus*. Antifungal activity was tested on Sabouraud dextrose agar (Hi-media) plates (26°C, 48–72 h) by cup plate method against *Candida albicans* and *Aspergillus niger* at the concentration level of 200, 100, and 50 µg/ml, ciprofloxacin and griseofulvin were used as a standards for comparison of antibacterial and antifungal activity under the similar conditions. DMSO was used as a solvent control for both antibacterial and anti fungal activities. The results are summarised in Tables 2 and 3, which include the activity of reference compound ciprofloxacin and griseofulvin, respectively. The tested compounds exhibit mild to moderate antibacterial activity against all four strains of bacteria. The compound **2** is active against *E. coli*, *P. aeruginosa*, and *S. aureus*, whereas compound **4** is active on *E. coli, P. aeruginosa* and *B subtilis*. It has also been observed that compound **6** showed activity against *S. aureus* whereas **8** is active on *E. coli*, *S. aureus* and *B. subtilis*.

The antifungal activity of the compounds was studied for the two pathogenic fungi. It was observed that compounds **2** and **4** have highest activity against *C. albicans* and *A. niger*, whereas compound **3** is active against *A. niger*. It has also been observed that compound **8** showed good activity against *C. albicans*.

Results and discussion

In conventional method, the yield of all these products is lower as compared to the yield obtained by microwave irradiation technique. Microwave irradiation method facilitates the polarization of the reacting molecule causing reactions to occur at higher rate. A comparative study in terms of yield and reaction time is shown in Table 1. The compounds (**1**–**7**) have been synthesised by condensation of isonicotinohydrazide and diethyl malonate (in glacial acetic acid) or acetyl acetone or 1-chloro-hexane-2,4-dione or hexane-2, 4-dione and acetic acid or ethyl 2-cyanoacetateor phenyl isothiocynate, respectively. Compound (**8**) has synthesised by the condensation reaction of (**7**) and ethylchloroacetate in presence of morpholine. These compounds have also been synthesised by the conventional method. It is noteworthy that the reaction, which required 5–12 h in conventional method, was completed within 2.00–3.30 min in microwave system at power level of 480–600 W. Yields have been remarkably improved from 46–57% to 75–88%.

The structures of the synthesised compounds (**1**–**8**) have been confirmed on the basis of spectral and elemental analysis. The IR spectra of compounds **1** and **2** exhibit bands at 1660, 1640 (C=O), 1230 (N–N) cm^{-1}. Further, in their ^{1}H NMR (δ, ppm DMSO-d_6) spectrum, the appearance of a signal at δ 3.45-3.40 (2H, d, CH_2 of pyrazoline) confirms the presence of the pyrazolidine-3, 5-Dione**.** The IR spectra of compounds (**3**–**6**) exhibited the stretching vibration band at 1606–1520 cm^{-1} due to (C=N, pyrazoline ring) and 1311–1234 (N–N), 1670–1660 (C=O), which indicate the presence of the pyrazol-5(4H)-one and -1H-pyrazole ring. Further, in their ^{1}H NMR (δ, ppm DMSO-d_6) spectrum the appearance of a signal at δ 3.51–3.26 (2H, d, CH_2 of pyrazoline), 6.20 (s, 1H, CH), confirms the presence of pyrazol-5(4H)-one and -1H-pyrazole ring. Similarly, the structures of compounds **7** and **8** were confirmed on the basis of spectral and elemental analysis. The IR spectrum of **7** exhibited a band due to 3410, 3362, 3342 (–NH), 1110 (C=S), their ^{1}H NMR

Table 2 In vitro antibacterial activity of compounds

Compd.	Inhibition zone diameter in mm											
	E. coli			*P. aeruginosa*			*S. aureus*			*B. subtilis*		
	50 μg/ml	100 μg/ml	200 μg/ml	50 μg/ml	100 μg/ml	200 μg/ml	50 μg/ml	100 μg/ml	200 μg/ml	50 μg/ml	100 μg/ml	200 μg/ml
1	16.20	18.10	20.20	12.10	13.20	16.10	08.40	12.00	18.10	10.20	12.00	16.00
2	**13.20**	**15.20**	**30.60**	18.20	22.80	28.00	10.00	22.00	26.10	10.20	18.90	25.10
3	14.30	23.00	28.50	10.20	18.60	25.00	14.00	23.00	24.00	10.40	18.50	22.90
4	14.20	23.00	30.40	14.00	22.10	28.60.	15.00	20.00	28.10	12.20	20.10	28.00
5	12.00	16.00	20.40	12.20	16.00	22.00	14.20	18.00	24.10	10.20	10.10	12.00
6	12.30	16.00	20.60	08.40	12.10	16.30	14.00	20.00	26.00	10.40	08.10	12.00
7	10.20	14.10	18.60	12.00	14.20	20.20	10.00	14.00	18.00	10.20	14.10	18.40
8	18.20	26.10	30.10	10.20	10.30	12.00	16.20	22.20	30.40	12.00	20.80	26.40
Norfloxacin	35.43	35.42	35.53	31.11	31.11	31.11	30.45	30.45	30.45	31.34	31.34	31.34

Table 3 In vitro antifungal activity of compounds

Compound	Inhibition zone diameter in mm					
	C. albicans			*A. niger*		
	50 μg/ml	100 μg/ml	200 μg/ml	50 μg/ml	100 μg/ml	200 μg/ml
1	06.20	10.10	10.20	10.10	12.20	14.10
2	13.20	18.20	24.20	12.20	16.80	24.00
3	14.30	20.00	24.50	10.20	18.60	25.00
4	14.20	23.00	26.40	14.00	22.10	26.60.
5	10.00	14.00	20.40	12.20	14.00	18.00
6	12.30	14.00	20.80	08.40	10.10	14.30
7	11.50	14.10	18.40	10.00	14.20	16.20
8	11.10	18.40	24.20	10.20	14.50	16.60
Clotrimazole	28.40	28.40	28.40	28.40	28.40	28.40

(δ, ppm DMSO-d_6) spectrum, appearance of a signal at δ 3.64 (s, H, HN–Ph), 3.84 (s, H, HN-dinitrophenyl hydrazine), 2.20 (s, H, HN–N); confirms the structure of **7** compound. The IR spectrum of **8** shows a band due to 3362 (–NH), 1649 (C=O), 1554 (C=N), 1235 (N–N) 742 (C–S–C); their ^{1}H NMR (δ, ppm DMSO-d_6) spectrum, appearance of a signal at 9.60(s, H, HN), 4.10 (s, 2H, CH_2) confirms the presence thiazolidin-4-one ring. The yields and the physical constants of the compounds synthesised by the conventional and microwave irradiation methods are given in Table 1.

The tested compounds exhibited mild to moderate antibacterial activity against all four strains of bacteria. The compound, **2** is active on *E. coli*, *P. aeruginosa S. aureus*, where as 4 is active on *E. coli*, *P. aeruginosa*, *B. subtilis.* It has also been observed that compounds **6** showed activity against *S. aureus*, and **8** is active on *E. coli*, *S. aureus* and *B. subtilis.*

The antifungal activity of the compounds was studied for the two pathogenic fungi. It was observed that compounds **2** and **4** had highest activity against *C. albicans* and *A. niger*, where as compound **3** is active against *A. niger*. It has also been observed that compound **8** showed good activity against *C. albicans.*

Thus, from these studies it can also be concluded that microwave technique is one of the promising technique of synthesis with better yield, less time consuming and provides green chemical pathway for the synthesis of various organic compounds. It is an eco-friendly technique.

Acknowledgements The authors are thankful to HOD, Department of Chemistry, University College of Science, M. L. Sukhadia University, Udaipur (Rajasthan) for providing laboratory facilities. Authors are also thankful to Director, CDRI Lucknow, India for providing spectral and analytical data. Special thanks to Dr. Ashok Kumar Sharma (A.D.) Regional Disease Diagnostic Center, Kota (Rajasthan) for antimicrobial screening.

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