ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 08 | August - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

AN ULTRASOUND MEDIATED GREEN SYNTHESIS OF 2-PYRAZOLINE DERIVATIVES

Pharma

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ABSTRACT

Pyrazolines are prominent nitrogen-containing heterocyclic compounds and therefore, various procedures have been worked out for their synthesis. After the pioneering work of Fischer and Knoevenagel in the 19th century, the reaction of α, β-unsaturated aldehydes and ketones with phenylhydrazine in acetic acid by refluxing became one of the most popular methods for the preparation of 2-pyrazolines. A series of substituted 2-pyrazolines was synthesized by ultrasound irradiated method to find out cleaner/ greener approaches.

KEYWORDS

Bischalcones, 2-pyrazolines, green synthesis, ultrasonic irradiation

1. INTRODUCTION

The importance of heterocyclic compounds in widely distributed fields of science can never be denied such as agricultural, bioorganic, industrial, inorganic, medicinal chemistry, organic, pharmaceutical, and material science etc. It takes extensive and unceasing efforts to work out some newer synthetic protocols for the production of different heterocyclic compounds (1). Clean (environment friendly) products or processes are essential for raising the quality of life in the era of industrialization or urbanization. In order to achieve such products or processes, different protocols have been developed to shorten the reaction times and under milder and more environmentally friendly conditions. During past few decades, use of ultrasonic irradiation has increased for various types of organic transformations in chemical literature (2). Ultrasonication has been explored as a chemical reactions accelerating method which involves the formation and adiabatic collapse of transient cavitation bubbles. Ultrasonication has been found to give reduced reaction times, higher yields, and milder conditions as compared to conventional methods (3-5). Recently, ultrasonication has been utilized to accelerate a wide number of synthetically useful organic reactions (9, 10). Such as ring opening of epoxides (3), alcohols protection (5), reduction of carbonyl compounds (6]) Suzuki cross-coupling reaction (4,7), acetylation of alcohols (8), aldol reaction (9), oximes synthesis (10), and reductive coupling of amines (11).

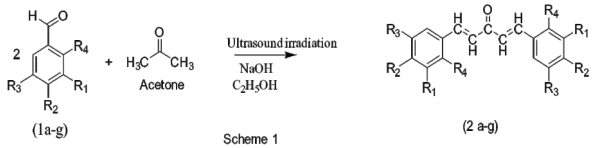
The Pyrazolines are basic in nature, having two adjacent nitrogen atoms within the five membered heterocyclic ring molecules and has only one endocyclic double bond (12-13). The N-N bond linkage present in pyrazoline ring is considered to be an important key factor for eliciting the pharmacological actions of heterocyclic compounds possessing this ring. The formation of this bond in living organisms involves great difficulty so naturally occurring pyrazolines are found to be less abundant (14). 2-pyrazoline has gained more attention among all possible isomers of pyrazoline due to its broad spectrum biological activities (15). Pyrazolines have been reported to exhibit a variety of biological activities including anti-tumour (16-17), anti-inflammatory (18-23), antiparasitary (24), anticonvulsant (25), antimicrobial (26-30), antinociceptive (31), antimalarial (32), nitric oxide synthase inhibitory, inflammatory arthritis (33), antidepressant (34,35), anticancer (36-38), antibacterial (26), analgesic (39), antioxidant (40), antiamoebic, cytotoxic (41-43), antifungal (44-45), antimycobacterial, antihepatotoxic (46) and pesticidal properties (47). After the pioneering work of Fischer and Knoevenagel in the 19th century, the reaction of α, β-unsaturated aldehydes and ketones with phenylhydrazine in acetic acid by refluxing became one of the most popular methods for the preparation of 2-pyrazolines (47). The conventional method of synthesis involves several hours of reaction along with higher temperature requirements (48-50) so ultrasonication mediated synthesis was tried out to promote the search and development of environment friendly greener methods.

2. RESULTS AND DISCUSSION

2.1 Chemistry

This study was aimed at abiding the green chemistry principles so the whole experiment focused at use of simple technique, minimum reactants, and non-toxic greener solvents. Pyrazoline derivatives' synthesis involves cyclocondensation of chalcones with hydrazines. In this study, α-β unsaturated ketones were synthesized as bis-chalcones followed by reaction with two different hydrazines, hydrazine hydrate and phenyl hydrazine by ultrasonic irradiation method.

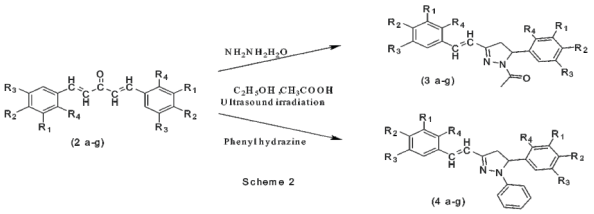
In the first part of this study, we proposed to synthesize 1,5- Substituted diphenylpenta-1,4-dien-3-one so different substituted benzaldehydes and acetone were reacted in a 2:1 ratio in the presence of ethanolic NaOH solution by aldol condensation in an ultrasonic bath Toshniwal SW-4,150W with ± 37 KHz output frequency. This reaction mixture was placed in an ultrasonic bath and introduced under ultrasonic waves at 12°C for 10–25 minutes to afford the substituted bischalcones. This reaction mixture was neutralized by pouring into ice cold 2N HCl. The resulting solution was suction filtered to collect solid product, which was washed with water, dried, and recrystallized from rectified spirit to afford the substituted bischalcones (Scheme 1).



(1a-g) (2 a-g)

Scheme 1

In the second part of this study, we aimed to synthesize 1-(5-Substituted phenyl-3-substituted styryl-4,5-dihydro-1H-pyrazol-1-yl)ethan-1-one and (E)-1-(5- Substituted phenyl)-3-(substituted styryl)-1-phenyl-4,5-dihydro-1H-pyrazole compounds. For synthesis of 1-(5- Substituted phenyl-3-substituted styryl-4,5-dihydro-1H-pyrazol-1-yl)-ethan-1-one, synthesized bis-chalcones were reacted with hydrazine hydrate in the presence of ethanol and glacial acetic acid. The conical flask was covered with porous parafilm. This reaction mixture was introduced under ultrasonic waves at 30°C for 5–25 minutes. After completion of the reaction, the alcohol was removed, and the resultant residue was neutralized by pouring into ice cold $NaHCO_3$solution. The resultant solid was suction filtered, washed with water, dried, and recrystallized from benzene. For synthesis of another set of pyrazolines, (E)-1-(5- Substituted phenyl)-3-(substituted styryl)-1-phenyl-4,5-dihydro-1H-pyrazole, bis-chalcones were reacted with phenylhydrazine and glacial acetic acid in ethanol. This reaction mixture was introduced under ultrasonic waves at 30°C for 5–25 minutes. After completion of the reaction, the alcohol was removed, and the resultant residue was neutralized by pouring into ice cold $NaHCO_3$solution. The resultant solid was suction filtered, washed with water, dried, and recrystallized from benzene (Scheme 2).



Scheme 2

Table 1 Physical Data of synthesized Pyrazoline Derivatives (1-(5-Substituted phenyl-3-substituted styryl-4,5-dihydro-1H-pyrazol-1-yl)-ethan-1-one)

Compound	X	Molecular Formula	Molecular Weight	Melting Point(°C)	Time Required (min.)	% Yield
3a	4-nitro benzaldehyde	$C_{19}H_{16}N_4O_5$	380.36	250-255	10	85
3b	2-nitro benzaldehyde	$C_{19}H_{16}N_4O_5$	380.36	248-253	14	79
3c	4-trifluoromethyl benzaldehyde	$C_{21}H_{16}F_6N_2O$	426.36	260-263	10	73
3d	4-methyl benzaldehyde	$C_{21}H_{22}N_2O$	318.42	213-217	15	72
3e	4-hydroxy benzaldehyde	$C_{19}H_{18}N_2O_3$	322.36	189-192	15	76
3f	Indole-3-aldehyde	$C_{23}H_{20}N_4O$	368.44	205-210	20	72
3g	Thiophene-2-aldehyde	$C_{15}H_{14}N_2OS_2$	302.41	78-82	14	73

X- substituted aldehydes

Table 2 Physical Data of synthesized Pyrazoline Derivatives (1-(5-Substituted phenyl)-3-(substituted styryl)-1-phenyl-4,5-dihydro-1H-pyrazole)

Compound	X	Molecular Formula	Molecular Weight	Melting Point (°C)	Time Required	% Yield
4a	4-nitro benzaldehyde	$C_{23}H_{18}N_4O_4$	414.42	216-218	15	68
4b	2-nitro benzaldehyde	$C_{23}H_{18}N_4O_4$	414.42	221-224	20	59
4c	4-trifluoromethyl benzaldehyde	$C_{25}H_{18}N_2F_6$	460.42	139-142	22	62
4d	4-methyl benzaldehyde	$C_{25}H_{24}N_2$	352.48	259-262	18	69
4e	4-hydroxy benzaldehyde	$C_{23}H_{20}N_2O_2$	346.43	238-241	22	73
4f	Indole-3-aldehyde	$C_{27}H_{22}N_4$	402.5	248-251	25	61
4g	Thiophene-2-aldehyde	$C_{19}H_{16}N_2S_2$	336.47	102-105	20	68

X- substituted aldehydes

3. MATERIAL & METHODS

3.1 Experimental

All melting points were determined in open glass capillary tubes and are uncorrected. The IR spectra (υ^{max} in cm^{-1}) were recorded on a Shimadzu IR spectrophotometer using potassium bromide pellets. PMR spectra were recorded using $CDCl_3$ as a solvent. TMS was used as an internal standard (chemical shift in δ ppm). The purity of compounds was checked by TLC using silica gel-G as an adsorbent and UV light– or iodine-accomplished visualization.

3.2 Synthesis of compounds 2 (a- g)

Substituted benzaldehydes and acetone were reacted in a 2:1 ratio in the presence of ethanolic NaOH solution by aldol condensation to synthesize 1,5-Substituted diphenyl-1,4-pentadien-3-ones. A mixture of substituted benzaldehydes (5 mmol), acetone (2.5 mmol, 0.14 g), and ground sodium hydroxide pellets (0.5 g) were placed in a conical flask. Ethanol (5 mL) was added, and the conical flask was covered with porous parafilm. This reaction mixture was placed in an ultrasonic bath and introduced under ultrasonic waves at 12°C for 10–25 minutes to afford the substituted bischalcones. This reaction mixture was neutralized by pouring into ice cold 2N HCl and the resulting solution was suction filtered to collect solid product. The product thus obtained was recrystallized from rectified spirit after washing to afford the substituted bischalcones. The purity of the product was determined by TLC by using the solvent system n-Hexane: ethyl acetate (8:2). After this, 15 mL of ethanol was taken in a 250 mL conical flask and a mixture of ground 1,5-substituted diphenyl-1,4-pentadien-3-one (2 mmol), hydrazine hydrate (16%, 1 mL), and glacial acetic acid (1 mL) was added to the conical flask which was then covered with porous parafilm. This reaction mixture was introduced under ultrasonic waves at 30°C for 15–25 minutes. After completion of the reaction, the alcohol was removed, and the resultant residue was neutralized by pouring into ice cold $NaHCO_3$ solution. The resultant solid was suction filtered, washed with water, dried, and recrystallized from benzene. The purity of the compound was determined with the help of TLC.

3.2.1 1-(5-(4-nitrophenyl)-3-(4-nitrostyryl)-4,5-dihydro-1H-pyrazol-1-yl)ethan-1-one (3a):Molecular Formula- $C_{19}H_{16}N_4O_5$; Mol. Wt.: 380.36; FT-IR (KBr, cm^{-1}): 3071 (C-H Ar str), 2886(C-H str), 1726 (C=O str), 1613, 1547, 1496 (C=C Ar str), 1613 (C=N), 1531(C-N str), 1331 (NO_2), ^{1}H NMR ($CDCl_3$, 400 MHz): 2.8 (s, 2H, CH_2, pyrazoline), 7.25-7.83(m, 4H, ArH), 6.83-8.18 (m, 4H, Ar H), 4.9 (s, 2H, methine of pyrazoline),7.24(m, CH=CH),1.9(s,3H) MS ES+ (ToF): *m/z* (M+1 381.45); CHN analysis: Calc.-C, 60; H, 4.24; N, 14.73; Found- C, 59.62; H, 4.32; N, 13.85.

3.2.2 1-(5-(2-nitrophenyl)-3-(2-nitrostyryl)-4,5-dihydro-1H-pyrazol-1-yl) ethan-1-one (3b) : Molecular Formula- $C_{19}H_{16}N_4O_5$; Mol. Wt.: 380.36; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1706 (C=O str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str); ^{1}H NMR ($CDCl_3$- 400 MHz 2.75 (s, 2H, CH_2, pyrazoline), 7.65-7.92(m, 4H, ArH), 7.03-8.21 (m, 4H, Ar H), 4.9 (s, 2H, methine of pyrazoline),7.24(m, CH=CH),1.98(s,3H) MS ES+ (ToF): *m/z* (M+1 381.45); CHN analysis: Calc.-C, 60; H, 4.24; N, 14.73; Found- C, 59.82; H, 4.25; N, 14.82.

3.2.3 1-(5-(4-trifluoromethyl)phenyl)-3-(4- (trifluoromethyl)styryl)-4,5-dihydro-1H-pyrazol-1-yl) ethan-1-one (3c) : Molecular Formula- $C_{21}H_{16}F_6N_2O$; Mol. Wt.: 426.36; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1706 (C=O str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str); ^{1}H NMR ($CDCl_3$, 400 MHz): 2.67 (s, 2H, CH_2, pyrazoline), 7.21-7.54(m, 4H, ArH), 7.42-7.57 (m, 4H, Ar H), 4.85 (s, H, methine of pyrazoline),6.95,7.24(m, CH=CH),1.96(s,3H)MS ES+ (ToF): *m/z* (M+1 427.45); CHN analysis: Calc.-, C, 59.16; H, 3.78; N, 6.57; Found- C, 59.02; H, 4.02; N, 6.35.

3.2.4 1-(3-(4-methylstyryl)-5-(p-tolyl)-4,5-dihydro-1H-pyrazol-1-yl) ethan-1-one (3d) : Molecular Formula- $C_{21}H_{22}N_2O$; Mol. Wt.: 318.42; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1706 (C=O str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str); ^{1}H NMR ($CDCl_3$, 400 MHz): 2.8,2.55 (s, 2H, CH_2, pyrazoline), 7.09-7.3(m, 4H, ArH), 7.3-7.6 (m, 4H, Ar H), 4.9 (s, 2H, methine of pyrazoline),7.64,6.9(m, CH=CH),1.96(s,3H),2.41 (s,3H),2.19 (s,3H) MS ES+ (ToF): *m/z* (M+1 319.45); CHN analysis: Calc.-C, 79.21; H, 6.96; N, 8.80; Found- C, 79.12; H, 6.82; N, 9.05.

3.2.5 1-(5-(4-hydroxyphenyl)-3-(4-hydroxystyryl)-4,5-dihydro-1H-pyrazol-1-yl)ethan-1-one (3e) :Molecular Formula- $C_{19}H_{18}N_2O_3$; Mol. Wt.: 322.36; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1706 (C=O str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str); ^{1}H NMR ($CDCl_3$- 400 MHz): 2.8,2.55 (s, 2H, CH_2, pyrazoline), 6.07-7.3(m, 4H, ArH), 6.5-7.4 (m, 4H, Ar H), 4.9 (s, H, methine of pyrazoline),7.64,6.9(m, CH=CH),1.96(s,3H),9.08 (s,OH),9.6 (s,OH), MS ES+ (ToF): *m/z* (M+1 323.45); CHN analysis: Calc.-C, 70.79; H, 5.63; N, 8.69; Found- C, 69.52; H, 5.39; N, 8.85.

3.2.6 1-(3-(2-(1H-indol-3-yl)vinyl-5-(1H-indol-3-yl)-4,5-dihydro-1H-pyrazol-1-yl) ethan-1-one (3f) : Molecular Formula- $C_{23}H_{20}N_4O$; Mol. Wt.: 368.44; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1706 (C=O str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str) ; ^{1}H NMR ($CDCl_3$, 400 MHz): 2.7,2.45 (s, 2H, CH_2, pyrazoline), 6.57-7.46(m, 4H, ArH), 6.79-7.62 (m, 4H, Ar H), 4.9 (s, H, methine of pyrazoline),7.64,6.9(m, CH=CH),1.9 (s,3H), 10.6 (s, 1H, Indole), 11.9 (s, 1H, Indole) MS ES+ (ToF): *m/z* (M+1 369.45); CHN analysis: Calc.-C, 74.98; H, 5.47; N, 15.21; Found- C, 74.02; H, 5.32; N, 14.97.

3.2.7 1-(5-(thiophen-2-yl)-3-(2-(thiophen-2-yl)-vinyl)-4,5-dihydro-1H-pyrazol-1-yl) ethan-1-one (3g) : Molecular Formula- $C_{15}H_{14}N_2OS_2$; Mol. Wt.: 302.41; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1706 (C=O str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str), 666(C-S bend) ; ^{1}H NMR ($CDCl_3$-*d*6, 400 MHz): 2.71,2.45(s, 2H, CH_2, pyrazoline), 6.8-7.3(m, 3H, ArH), 6.79-7.35(m, 3H, Ar H), 4.9 (s, H, methine of pyrazoline),6.64,6.6(m, CH=CH),1.9 (s,3H), MS ES+ (ToF): *m/z* (M+1 303.45); CHN analysis: Calc.-C59.58; H, 4.67; N, 9.26; Found- C, 59.62; H, 4.32; N, 8.85.

3.3 Synthesis of compounds 4(a- g)

15 mL of ethanol was taken in a 250 mL conical flask and a mixture of ground 1,5-substituted diphenyl-1,4-pentadien-3-one 3 (2 mmol), phenylhydrazine (2mmol), and glacial acetic acid (1 mL) was added to the conical flask. The conical flask was covered with porous parafilm. This reaction mixture was introduced under ultrasonic waves at 30°C for 15–25 minutes. After completion of the reaction, the alcohol was removed, and the resultant residue was neutralized by pouring into ice cold $NaHCO_3$ solution. The resultant solid was suction filtered, washed with water, dried, and recrystallized from benzene. The purity of the compound was determined with the help of TLC. The solvent system selected was n-Hexane: ethyl acetate (8:2).

3.3.1 5-(4-nitrophenyl)-3-(4-nitrostyryl)-1-phenyl-4,5-dihydro-1H-pyrazole (4a): Molecular Formula- $C_{23}H_{18}N_4O_4$; Mol. Wt.: 414.42; FT-IR (KBr, cm^{-1}): 3050 (CH str), 3008 (C-H Ar str), 2866(C-H str), 1626, 1545, 1463 (C=C Ar str), 1644(C=N str), 1514 (C-N str); ^{1}H NMR ($CDCl_3$,400 MHz): 2.71,2.45(s, 2H, CH_2, pyrazoline), 8.0-8.3(m, 4H, ArH), 7.5-8.1(m, 4H, Ar H),6.9-7.3(m, 5H, ArH), 5.9 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH), MS ES+ (ToF): *m/z* (M+1 415.45); CHN analysis: Calc.-C, 66.66; H, 4.34; N, 13.52; Found- C, 65.71; H, 4.30; N, 13.85.

3.3.2 5-(2-nitrophenyl)-3-(2-nitrostyryl)-1-phenyl-4,5-dihydro-1H-pyrazole (4b): Molecular Formula- $C_{23}H_{18}N_4O_4$; Mol. Wt.: 414.42; FT-IR (KBr, cm^{-1}): 3250 (CH str), 3180 (C-H Ar str), 2810(C-H str), 1616, 1463 (C=C Ar str), 1662(C=N str), 1534 (C-N str); ^{1}H NMR ($CDCl_3$,400 MHz): 2.71,2.45(s, 2H, CH_2, pyrazoline), 8.0-8.3(m, 4H, ArH), 7.5-8.1(m, 4H, Ar H),6.9-7.3(m, 5H, ArH), 5.9 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH), MS ES+ (ToF): *m/z* (M+1 415.45); CHN analysis: Calc.-C, 66.66; H, 4.34; N, 13.52; Found- C, 65.76; H, 4.29; N, 13.79.

3.3.3 1-phenyl-5-(4-(trifluoromethyl)phenyl)-3-(4-(trifluoromethyl) styryl)-4,5-dihydro-1H-pyrazole (4c): Molecular Formula- $C_{25}H_{18}N_2F_6$; Mol. Wt.: 460.42; FT-IR (KBr, cm^{-1}): 3250 (CH str), 3180 (C-H Ar str), 2810(C-H str), 1575, 1463 (C=C Ar str), 1662(C=N str), 1534 (C-N str); ^{1}H NMR ($CDCl_3$,400 MHz): 2.7,2.5(s, 2H, CH_2, pyrazoline), 7.11-7.35(m, 4H, ArH), 6.8-7.3(m, 4H, Ar H),6.8-7.2(m, 5H, ArH), 5.19 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH), MS ES+ (ToF): *m/z* (M+1 461.45); CHN analysis: Calc.-C, 65.22; H, 3.94; N, 6.08; Found- C, 64.76; H, 3.86; N, 6.12.

3.3.4 3-(4-methylstyryl)-1-phenyl-5-(p-tolyl)-4,5-dihydro-1H-pyrazole (4d): Molecular Formula- $C_{25}H_{24}N_2$; Mol. Wt.: 352.48; FT-IR (KBr, cm^{-1}): 3350 (CH str), 3210 (C-H Ar str), 2715(C-H str), 1626, 1550, 1435 (C=C Ar str), 1642(C=N str), 1554 (C-N str); ^{1}H NMR($CDCl_3$,400 MHz): 2.71,2.45(s, 2H, CH_2, pyrazoline), 6.8-7.2(m, 5H, ArH), 7.3-7.5(m, 4H, Ar H),7.02-7.28(m, 4H, ArH), 5.9 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH),2.1 (s,3H),2.4(s,3H) MS ES+ (ToF): *m/z* (M+1 353.53); CHN analysis: Calc.-C, 85.19; H, 6.86; N, 7.95; Found- C, 86.06; H, 6.29; N, 8.79.

3.3.5 4-(2-(5-(4-hydroxyphenyl)-1-phenyl-4,5-dihydro-1H-pyrazol-3-yl)vinyl)phenol (4e): Molecular Formula- $C_{23}H_{20}N_2O_2$; Mol. Wt.: 356.15; FT-IR (KBr, cm^{-1}): 3420 (O-H), 3350 (CH str), 3210 (C-H Ar str), 2715(C-H str), 1626, 1550, 1435 (C=C Ar str), 1642(C=N str), 1554 (C-N str); ^{1}H NMR ($CDCl_3$,400 MHz): 2.77,2.52(s, 2H, CH_2, pyrazoline), 6.8-7.2(m, 5H, ArH), 6.8-7.2(m, 4H, Ar H),7.02-7.28(m, 4H, ArH), 5.19 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH),9.68(s,1H,OH),9.06(s,1H, OH) MS ES+ (ToF): *m/z* (M+1 357.05); CHN analysis: Calc.-C, 77.51; H, 5.66; N, 7.86; Found- C, 76.96; H, 5.69; N, 7.79

3.3.6 3-(2-(5-(1H-indol-3-yl)-1-phenyl-4,5-dihydro-1H-pyrazol-3-yl)vinyl)-1H-indole (4f): Molecular Formula- $C_{27}H_{22}N_4$; Mol. Wt.: 402.5; FT-IR (KBr, cm^{-1}):), 3235 (CH str), 3260 (C-H Ar str), 2735(C-H str), 1626, 1550, 1435 (C=C Ar str), 1614(C=N str), 1554 (C-N str); ^{1}H NMR ($CDCl_3$,400 MHz): 2.47,2.61(s, 2H, CH_2, pyrazoline), 6.9-7.3(m, 5H, ArH), 6.8-7.3(m, 4H, Ar H),7.02-7.68(m, 4H, ArH), 5.19 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH), 10.7(s,1H, indole), 11.9 (s,1H, indole) MS ES+ (ToF): *m/z* (M+1 403.45); CHN analysis: Calc.-C, 80.57; H, 5.51; N, 13.92; Found- C, 79.62; H, 5.62; N, 13.85.

3.3.7 1-phenyl-5-(thiophen-2-yl)-3-(2-(thiophen-2-yl)-vinyl)-4,5-dihydro-1H-pyrazole (4g): Molecular Formula- $C_{19}H_{16}N_2S_2$; Mol. Wt.: 336.47; FT-IR (KBr, cm^{-1}): 3150 (CH str), 3080 (C-H Ar str), 2820(C-H str), 1640, 1580, 1462 (C=C Ar str), 1654(C=N str), 1514 (C-N str), 695(C-S bend) ; ^{1}H NMR ($CDCl_3$,400 MHz): 2.44,2.69(s, 2H, CH_2, pyrazoline), 6.83-7.35(m, 5H, ArH), 6.8-7.3(m, 4H, Ar H),6.82-7.18(m, 4H, ArH), 5.19 (s, H, methine of pyrazoline),7.51,7.17(m, CH=CH), MS ES+ (ToF): *m/z* (M+1 337.45); CHN analysis: Calc.-C, 67.82; H, 4.79; N, 8.33; Found- C, 67.62; H, 4.82; N, 8.65.

CONCLUSION

It can be concluded that starting with bischalcones derived from various substituted aldehydes and then cyclocondensation with hydrazines under ultrasonic radiations can be successfully synthesized with an objective of environment friendly, short time consuming and high yield resulting method.

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