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Synthesis and Antimicrobial Activity of 5-(Substituted-Phenyl)-3-(Furan-2-Yl)-4,5-Dihydro-1H-Pyrazole Compounds Using Silver Trifluro Methane Sulphonate as Catalyst

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ABSTRACT

A series of 5-(Substituted-phenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole were synthesized which contained pyrazole and furan ring in their ring structure. The target compound was synthesized by the reaction of hydrazine hydrate with various chalcone in the presence of ethanol. The intermediate chalcone was synthesized reaction of various acetophenone with furfural aldehyde in the presence of ethanol. All compounds were screened for their in-vitro antimicrobial activity against five bacterial strains Bacillus subtilis, Staphylococcus aureus, Staphylococcus epidermis and Escherichia coli, Pseudomonas aeruginosa, (Gram-negative) and on two fungal strains Aspergillus niger and Candida albicans by serial two-fold dilution method and the minimum inhibitory concentration (MIC) was determined. On the bases of structure activity relationship (SAR) study it was found that electron-withdrawing or halogens groups contained phenyl ring had found effectively antimicrobial activity. In, conclusion it was found that it was found that compound 2 (R=NO_2) was most potent compound of this series due to presence of NO_2 group.

Keywords: Pyrazole, Chalcone, Antimicrobial, Minimum Inhibitory Concentration (MIC).

INTRODUCTION

The rate of morbidity and mortality is increased antibiotic resistance is current worldwide health issue due to excessive use of antimicrobial drugs [1]. As result an effective, the discovery of new antimicrobial agent's appeal. The compound containing pyrazole nucleus exhibited various biological activities such as antimicrobial [2-5], anti-inflammatory [6-8], antiviral [9,10], antitumor activities [11-13] and antimalarial [14,15]. Pyrazole is five-membered heterocycles compounds which contain two neighbouring nitrogen atoms in their ring structure. Pyrazole associated with the group of azoles in which two double bonds are present with the molecular formula of $C_3H_4N_2$ [16,17]. Buchner, in 1889 first time described pyrazole on heating pyrazole-3,4,5-tricarboxylic acid at 230-240°C [18]. The synthesized compounds were characterized on the basis of IR and ^{1}H NMR spectral data. All compounds were screened for their *in-vitro* antimicrobial activity against five bacterial strains *Bacillus subtilis, Staphylococcus aureus, Staphylococcus epidermis and Escherichia coli, Pseudomonas aeruginosa,* (Gram-negative) and on two fungal strains *Aspergillus niger* and *Candida albicans* by serial two-fold dilution method and the minimum inhibitory concentration (MIC) was determined.

MATERIALS AND METHODS

Chemistry

5-phenyl-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole were prepared by reaction of hydrazine hydrate with various chalcone in the presence of ethanol. The intermediate chalcone was synthesized reaction of various acetophenone with furfural aldehyde in the presence of ethanol (aldol condensation or Claisen-Schmidt reaction). Method is reported. The physicochemical characterization of synthesized Compounds 1-14 is given in Table 1.

Table 1: Physicochemical characterization of synthesized compounds 1-14.

Compound	R	Molecular Formula	Molecular Weight	Melting Point (°C)	R_f Value	% yield
1	3',4'-OCH_3	$C_{15}H_{16}N_2O_3$	272.30	140	0.58	47.90
2	4-NO_2	$C_{13}H_{11}N_3O_3$	257.25	290	0.63	38.19
3	4-Br	$C_{13}H_{11}BrN_2O$	291.15	110	0.54	41.34
4	2',4'-OH	$C_{13}H_{12}N_2O_3$	244.25	387	0.49	32.90
5	4-OCH_3	$C_{14}H_{14}N_2O_2$	242.28	124	0.28	6.52
6	4-OH	$C_{13}H_{12}N_2O_2$	228.25	180	0.62	7.48
7	4-NH_2	$C_{13}H_{13}N_3O$	227.27	157	0.67	40.08
8	2-OH	$C_{13}H_{12}N_2O_2$	228.25	180	0.57	21.27
9	4-CH_3	$C_{14}H_{14}N_2O$	226.28	110	0.53	24.69
10	4-Cl	$C_{13}H_{11}ClN_2O$	246.69	122	0.43	21.52
11	2-Br-4-Cl	$C_{13}H_{10}BrClN_2O$	325.59	155	0.72	23.84
12	2-Cl	$C_{13}H_{11}ClN_2O$	246.69	122	0.65	22.11

13	4-F	$C_{13}H_{11}FN_2O$	230.24	106.5	0.58	5.20
14	2',4'-Cl	$C_{13}H_{10}C_{l2}N_2O$	281.14	142.5	0.41	21.77

Melting points were measured in open glass capillaries on melting point apparatus and ^{1}H-NMR spectra was recorded on Bruker Avance 400 MHz (^{1}H) spectrometer with multinuclear broad band observed prove in DMSO-d_6 with tetra methyl silane (TMS) as internal standard. IR spectra were recorded in FT-IR Spectrophotometer (Perkin Elmer Spectrophotometer). All the chemicals used were of analytical grade and used without further purification. The completion of the reactions was monitored by thin layer chromatography (TLC) using silica gel G (Himedia labs Pvt. Ltd, Mumbai). The plates were visualized by exposing to Iodine chamber. TLC Solvent system- Chloroform: Touline (7:3 v/v). The synthesis 5-(substituted-phenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole is given in Figure 1.

Synthesis of Chalcone

The equal molar quantity of acetophenone and furfural aldehyde (0.02 mol) was dissolved in 10 ml of ethanol and stirred it for 5 min. Add 12 ml of aqueous NaOH solution (2 g in 20 ml) drop-wise. Stirred the mixture for 3-4 hours at 20-25°C. Check the reaction by TLC. Add 300 ml of water with constant stirring. In the case of hydroxy acetophenone, the reaction mixture was neutralized by 0.02N HCl there was the formation of precipitates. Keep reaction mixture overnight in the refrigerator. The precipitate formed and filtered and washed with water than recrystallized from ethanol. Dry the product and determined the formation of chalcone by TLC.

Synthesis of 5-phenyl-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole Derivatives (1-14)

10 m mole of chalcone was dissolved in 10 ml of ethanol. Laterally 1ml of hydrazine hydrate and catalytic quantity (10 mg) of Compounds Using Silver trifluro methane sulphonate as Catalyst. (silver triflate) were added into the solution of chalcone. Reflux the reaction mixture for 60-90 minutes and cool the reaction mixture. Adjust the pH 7.0 of the reaction mixture by using NaOH. Filter the solid mass and wash with cold R.O water and further recrystallized by ethanol and in the result, furan-pyrazole derivatives were obtained and monitored by TLC and note down the Rf value.

The compound further subjected for various spectral analysis [19]. The progress of reaction was monitored by TLC using Toluene: Chloroform in the ratio of (3:7 v/v) as mobile phase.

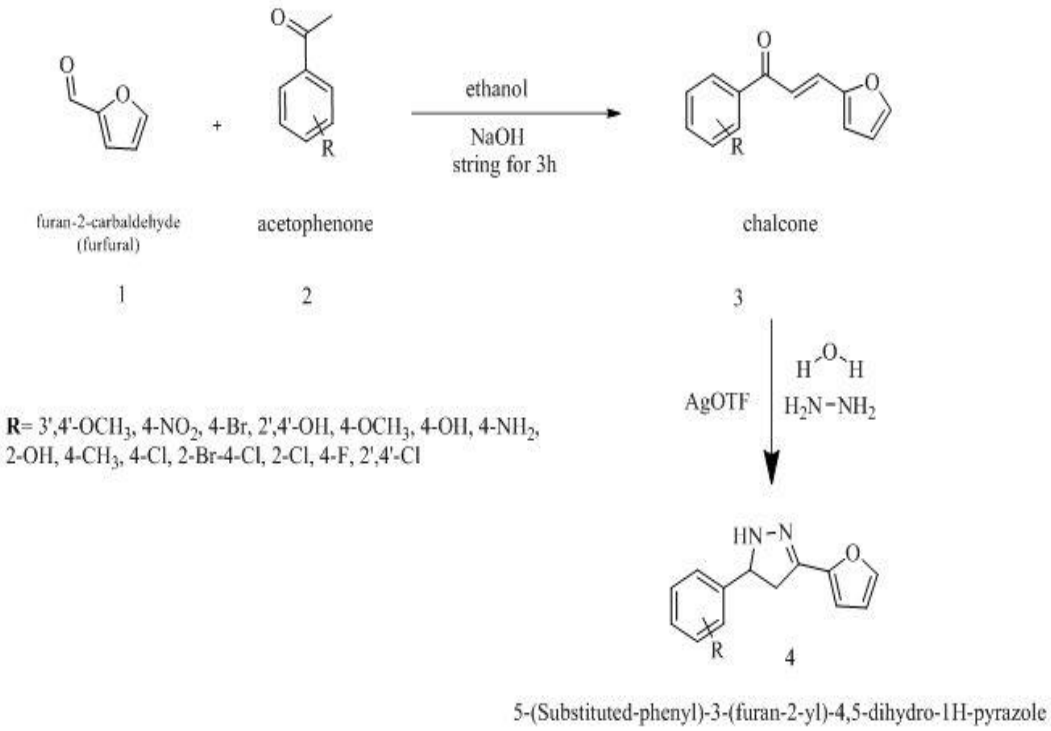


Figure 1: Synthesis of 5-(Substituted-phenyl)-3-(furan-2-yl)-4-5-dihydro-1H-pyrazole

Spectral data of all synthesized compounds

5-(3,4-dimethoxyphenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [1]

Yield 65.24%; m.p. 140°C; IR (KBr, cm^{-1}): 1153.17 (C-O-CH_3), 1569.4 (C=C, Ar), 3004.21 (C-H, Ar), 844.20 (C-C), 1294.69 (C-NH), 3448.16 (N-H), 1596.14 (N=C), 1259.11 (C-O); ^{1}H- NMR (DMSO-d_6): δ 3.36 (s, 3H, CH_3), 3.42 (s, 3H, CH_3), 8.60 (d, N-H, pyrazole), 7.28 -7.64 (m, 6H, Ar-H), 3.4 (d, 1H, Al-H).

3-(furan-2-yl)-5-(4-nitrophenyl)-4,5-dihydro-1H-pyrazole [2]

Yield 67.33%; m.p. 290°C; IR (KBr, cm^{-1}): 1341.48 (NO_2), 1559.14 (C=C, Ar), 3063.76 (C-H, Ar), 852.62 (C-C), 1302.28 (C-NH), 3336.56 (N-H), 1594.15 (N=C), 1076.44 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.24 (d, N-H, pyrazole), 6.38 -8.17 (m, 7H, Ar-H), 3.40 (d, 1H, Al-H).

5-(4-bromophenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [3]

Yield 64.20%; m.p. 110°C; IR (KBr, cm^{-1}): 535.31 (C-Br), 1397.02 (C=C, Ar), 738.94 (C-H, Ar), 884.72 (C-C), 1345.74 (C-NH), 3355.57 (N-H), 1586.74 (N=C), 1071.78 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.84 (d, N-H, pyrazole), 7.13-7.86 (m, 7H, Ar-H), 3.3 (d, 1H, Al-H).

4-(3-(furan-2-yl)-4,5-dihydro-1H-pyrazol-5-yl)benzene-1,3-diol [4]

Yield 66.38%; m.p. 387°C; IR (KBr, cm^{-1}): 3401.91 (OH), 13.62 (C=C, Ar), 742.86 (C-H, Ar), 804.45 (C-C), 1114.11 (C-NH), 3763.61 (N-H), 1542.74 (N=C), 1127.38 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.71, 9.23 (s, O-H), 8.34 (d, N-H, pyrazole), 7.28-7.86 (m, 6H, Ar-H), 3.52 (d, 1H, Al-H).

3-(furan-2-yl)-5-(4-methoxyphenyl)-4,5-dihydro-1H-pyrazole [5]

Yield 56.23%; m.p. 124°C; IR (KBr, cm^{-1}): 1111.36 (C-O-CH_3), 1426.14 (C=C, Ar), 737.99 (C-H, Ar), 831.83 (C-C), 1251.77 (C-NH), 3432.18 (N-H), 1603.92 (N=C), 1173.45 (C-O); ^{1}H- NMR (DMSO-d_6): δ 3.34(s, 3H, CH_3), 8.09 (d, N-H, pyrazole), 6.69-7.98 (m, 7H, Ar-H), 3.79 (d, 1H, Al-H).

4-(3-(furan-2-yl)-4,5-dihydro-1H-pyrazol-5-yl)phenol [6]

Yield 59.43%; m.p. 180°C; IR (KBr, cm^{-1}): 3277.51 (C-OH), 1601.39 (C=C, Ar), 832.95 (C-H, Ar), 1009.73 (C-C), 1009.73 (C-NH), 1519.09 (N=C), 1071.04 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.62 (s, O-H), 8.12 (d, N-H, pyrazole), 7.22-7.57 (m, 7H, Ar-H), 3.34 (d, 1H, Al-H).

4-(3-(furan-2-yl)-4,5-dihydro-1H-pyrazol-5-yl)aniline [7]

Yield 62.10%; m.p. 157°C; IR (KBr, cm^{-1}): 3459.02 (NH_2), 1608.27 (C=C, Ar), 3095.03 (C-H, Ar), 1114.55 (C-C), 1284.18 (C-NH), 3319.45 (N-H), 1637.73 (N=C), 1233.07 (C-O); ^{1}H- NMR (DMSO-d_6): δ 3.98 (s, 2H, NH_2), 8.62 (s, O-H), 8.28 (d, N-H, pyrazole), 7.22-7.57 (m, 7H, Ar-H), 3.38 (d, 1H, Al-H).

2-(3-(furan-2-yl)-4,5-dihydro-1H-pyrazol-5-yl)phenol [8]

Yield 65.23%; m.p. 180°C; IR (KBr, cm^{-1}): 3432.83 (OH), 1498.00 (C=C, Ar), 825.92 (C-H, Ar), 1112.33 (C-C), 1345.38 (C-NH), 3336.46 (N-H), 1601.01 (N=C), 1298.13 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.48 (s, O-H), 8.62 (d, N-H, pyrazole), 7.18-7.69 (m, 7H, Ar-H), 3.14 (d, 1H, Al-H).

3-(furan-2-yl)-5-(p-tolyl)-4,5-dihydro-1H-pyrazole [9]

Yield 68.20%; m.p. 110°C IR (KBr, cm^{-1}): 1406.97 (CH_3-C), 1606.93 (C=C, Ar), 737.28 (C-H, Ar), 813.89 (C-C), 1180.78 (C-NH), 3336.46 (N-H), 3404.30 (N=C), 1112.15 (C-O); ^{1}H- NMR (DMSO-d_6): δ 3.34(s, 3H, CH_3), 8.15 (d, N-H, pyrazole), 7.11 - 7.78 (m, 7H, Ar-H), 3.4 (d, 1H, Al-H).

5-(4-fluorophenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [10]

Yield 56.28%; m.p. 122°C; IR (KBr, cm^{-1}): 596 (Cl), 1400.01 (C=C, Ar), 736.68 (C-H, Ar), 883.88 (C-C), 1347.88 (C-NH), 3422.94 (N-H), 1590.72 (N=C), 1091 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.82 (d, N-H, pyrazole), 7.15-7.82 (m, 7H, Ar-H), 3.2 (d, 1H, Al-H).

5-(2-bromo-4-chlorophenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [11]

Yield 63.20%; m.p. 155°C; IR (KBr, cm^{-1}): 619.27 (Br), 736.92 (Cl), 1490.77 (C=C, Ar), 828.85 (C-H, Ar), 1013.04 (C-C), 1399.59 (C-NH), 3402.32 (N-H), 1602.44 (N=C), 1093.60 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.14 (d, N-H, pyrazole), 7.11-7.78 (m, 6H, Ar-H), 3.34 (d, 1H, Al-H).

5-(2-chlorophenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [12]

Yield 65.84%; m.p. 122°C; IR (KBr, cm^{-1}): 597.82 (Cl), 1443.90 (C=C, Ar), 737.13 (C-H, Ar), 883.75 (C-C), 1012.61 (C-NH), 3393.16 (N-H), 1602.58 (N=C), 1109.18 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.92 (d, N-H, pyrazole), 7.26-7.92 (m, 7H, Ar-H), 3.48 (d, 1H, Al-H).

***5-(4-chlorophenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [13*]**

Yield 62.18%; m.p. 106.5°C; IR (KBr, cm^{-1}): 1408.10 (F), 1508.45 (C=C, Ar), 738.23 (C-H, Ar), 883.88 (C-C), 1355.21 (C-NH), 3431.25 (N-H), 1601.42 (N=C), 1111.98 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.90 (d, N-H, pyrazole), 7.16-7.52 (m, 7H, Ar-H), 3.38 (d, 1H, Al-H).

5-(2,4-dichlorophenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole [14]

Yield 57.23%; m.p. 142.5°C; IR (KBr, cm^{-1}): 597.33 (Cl), 1466.24 (C=C, Ar), 734.61 (C-H, Ar), 866.07 (C-C), 1189.06 (C-NH), 3422.20 (N-H), 1582.82 (N=C), 1107.25 (C-O); ^{1}H- NMR (DMSO-d_6): δ 8.84 (d, N-H, pyrazole), 7.15-7.87 (m, 6H, Ar-H), 3.52 (d, 1H, Al-H).

Antimicrobial activity

All the synthesized derivatives were evaluated for their antibacterial activity against *Bacillus subtilis*, *Staphylococcus aureus*, *Staphylococcus epidermis* (Gram-positive) *and Escherichia coli*, *Pseudomonas aeruginosa*, (Gram-negative) and antifungal activity against two fungal strains *Aspergillus niger* and *Candida albicans* by serial two-fold dilution method and the minimum inhibitory concentration (MIC) was determined. Ciprofloxacin and Fluconazole were used as the standard antibacterial and antifungal drug respectively.

The result of antimicrobial studies indicates that compound 1 is moderate active on fungus *A. niger* and less active on all other strains. Compound 2 was most potent on *B. subtilis*, *S. aureus* and on *P. aeruginosa* and moderate active on *E. coli* and one fungal strain *C. albicans* and less active on all other strains. It may due to the presence of NO_2 group at position 4. Compound P3 is most active on *S. epidermis* and moderate active on *E. coli* and less active on all other strains it may due to the presence of Br group. Compound 4 moderate active on *S. aureus* & *E. coli* and on one fungal strain *A. niger*. less active on all other bacterial strains. Compound 5 showed moderate activity on both bacterial and fungal strains expect on *B. subtilis* and *S. aureus*. Compound 6 moderate active on *S. aureus*, *E. coli* and *P. aeruginosa* and on one fungal strain *A. niger* and less active on all other strains. Compound 7 moderate active only on one fungal strain *A. niger* and less active on all other strains. Compound 8 moderate active on *S. epidermis* and on *E. coli* and also on both fungal strain and less active on all other strains. Compound 9

most potent on one fungal strain *A. niger* and moderate activity on *B. subtilis, S. epidermis* and on *E. coli* and less active on all other strains. It may due to presence of CH_3 group. Compound 10 most potent on *B. subtilis* and on one fungal strain *C. albicans* it may due to presence of Cl group at position 4 and showed moderate activity on all other strains. and less potent on *S. aureus*. Compound 11 most potent on *B. subtilis* and on one fungal strain *C. albicans* it may due to presence of Cl group at position 4 and showed moderate activity on all other strains. Compound 12 most potent on *E. coli* and moderate active on one fungal strain *A. niger* and less active on all other strains. It may due to presence of Cl group at position 2. Compound 13 found to most potent on *S. aureus, P. aeruginosa* and on one fungal strain *A. niger*. Compound 14 most potent on *B. subtilis* and *E. coli* and on one fungal strain *C. albicans* it may due to presence of Cl group at position 2 and 4 and showed moderate activity on all other strains and less potent on *S. aureus* [15-19] (Figure 2).

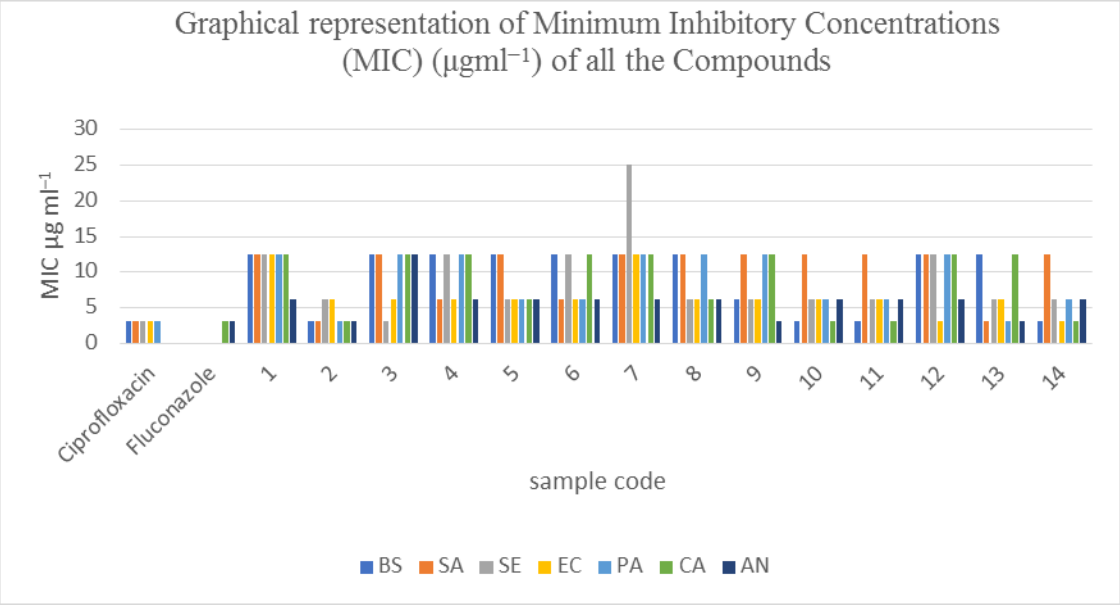


Figure 2: Graphical representation of Minimum Inhibitory Concentrations (MIC) (µgml−1) of all the compounds

BS= Bacillus subtilis, SA= Staphylococcus aureus, SE= Staphylococcus epidermis, EC= Escherichia coli, PA= Pseudomonas aeruginosa, CA= Candida albicans, AN= Aspergillus niger.

Microbiology

All the synthesized compounds were screened for *in-vitro* antimicrobial activity against bacterial strains *Bacillus subtilis* (MTCC 2063), *Staphylococcus aureus* (MTCC 3160), *Staphylococcus epidermis* (MTCC 435), *Escherichia coli* (MTCC 40), *Pseudomonas aeruginosa* (MTCC 425) and fungal strains *Candida albicans (*MTCC 227), and *Aspergillus niger* (MTCC 8652) by using serial dilution method [20], minimum inhibitory concentration (MIC) to be determined. The exact amount of nutrient broth or sabouraud dextrose was weighed and dissolved in 1L of distilled water. Then, 1 mL of nutrient medium was transferred to each test tube. The test tubes having a nutrient medium were autoclave at 120°C for 30 minutes. The solution of test compound was prepared by adding 10mg of synthesized compounds in 10ml DMSO. Then 1ml of this solution was

diluted with DMSO up to 10ml to give a stock solution of 100 µg/ml. The solution of test compound was transferred in one test tube and serially diluted to give a concentration 50, 25, 12.5, 6.25 and 3.125 µg/ml. To all the test tubes 0.1 ml of the suspension of bacteria in saline was added. The inoculation of the test strains was done with the help of micropipette with sterilized tips. The freshly cultured strain was transferred to the test tubes and incubated at 37°C for 24 h for bacterial strains, 48 h for *Candida albicans* and 7 days at 25°C for *A. niger*. The potency of the target compounds was tested against the microbes and compared with standard drugs Ciprofloxacin and Fluconazole for antibacterial and antifungal activity respectively. The MIC values were determined as the lowest concentration that completely inhibited visible growth of the microorganisms. The MIC values are given in Table 2.

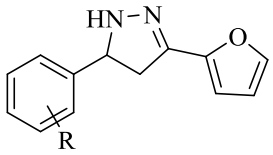
Table 2: Anti-microbial data for the synthesized derivatives.

	Gram-positive	**Gram-negative**		**Fungus**			
Comps	**MIC (*BS*)**	**MIC (*SA*)**	**MIC (*SE*)**	**MIC (*EC*)**	**MIC (*PA*)**	**MIC (*CA*)**	**MIC (*AN*)**
1	12.5	12.5	12.5	12.5	12.5	12.5	6.25
2	**3.12**	**3.12**	6.25	6.25	**3.12**	**3.12**	**3.12**
3	12.5	12.5	**3.12**	6.25	12.5	12.5	12.5
4	12.5	6.25	12.5	6.25	12.5	12.5	6.25
5	12.5	12.5	6.25	6.25	6.25	6.25	6.25
6	12.5	6.25	12.5	6.25	6.25	12.5	6.25
7	12.5	12.5	25	12.5	12.5	12.5	6.25
8	12.5	12.5	6.25	6.25	12.5	6.25	6.25
9	6.25	12.5	6.25	6.25	12.5	12.5	**3.12**
10	**3.12**	12.5	6.25	6.25	6.25	**3.12**	6.25
11	**3.12**	12.5	6.25	6.25	6.25	**3.12**	6.25
12	12.5	12.5	12.5	**3.12**	12.5	12.5	6.25
13	12.5	**3.12**	6.25	6.25	**3.12**	12.5	**3.12**
14	**3.12**	12.5	6.25	**3.12**	6.25	**3.12**	6.25
Ciprofloxacin	3.12	3.12	3.12	3.12	3.12	-	-
Fluconazole	-	-	-	-	-	3.12	3.12

RESULT AND DISCUSSION

The structure of newly synthesized compounds was confirmed by IR and ^{1}H NMR spectra. Spectral data of the newly synthesized compounds 1-14 were in full agreement with the proposed structures. In the 1H NMR spectra of 1-14. N-H of the pyrazole ring displayed signal around δ 8.9-8.84. The IR spectra of 1-14 showed a characteristic absorption band around 1298-1011 cm^{-1} that was assigned to the C-O stretching. The absorption band around 3448.16-3319.48 cm^{-1} that was assigned to the N-H stretching. The absorption band around 1608.27-1397.02 cm^{-1} that was assigned to the C=C (Ar) stretching. he absorption band around 3095.03-3004.21 cm^{-1} that was assigned to the C-H (Ar), 828-734 cm^{-1} for C-H (Ar out- of- plane) stretching. the absorption

band around 1114.55-813.89 cm^{-1} that was assigned to the C-C stretching. The absorption band around 16776.31-1519.09 cm^{-1} that was assigned to the C=N stretching. While the absorptions bands around 1026.02-1006.34 cm^{-1} that was assigned to the Pyrazole-Ring vibration.



5-(Substituted-phenyl)-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole

Bacterial activity

All the synthesized compounds were evaluated for their antibacterial activity against *Bacillus subtilis, Staphylococcus aureus, Staphylococcus epidermis* (Gram-positive) *and Escherichia coli, Pseudomonas aeruginosa,* (Gram-negative) *albicans* by serial two-fold dilution method and the minimum inhibitory concentration (MIC) was determined. Ciprofloxacin were used as the standard antibacterial drug.

it was found that compounds 2 (**R**=3',4'OCH_3), 10 (**R**=4-Cl), 11 (**R**=2-Br-4Cl) and 14 actives against *Bacillus subtilis*. Compounds 2 and 13 actives against *Staphylococcus aureus*. Compound 3 (**R**=4-Br) active against *Staphylococcus epidermis*. Compounds 12 (**R**=2-Cl) and 14 (**R**=2',4'-Cl) active against *E. coli*.

Fungal activity

All the synthesized compounds were evaluated for their antifungal activity against two fungal strains *Aspergillus niger* and *Candida albicans* by serial two-fold dilution method and the minimum inhibitory concentration (MIC) was determined. Fluconazole were used as the standard antifungal drug.

it was found that compounds 2 (**R**=NO_2) and 13 (**R**=4-F) active against *Pseudomonas aeruginosa* as compared to standard drug Ciprofloxacin while compound 2 (**R**=NO_2) active against both Fungal strains and Compound 10 (**R**=4-Cl), 11 (**R**=2-Br-4-Cl) and 14 (**R**=2',4'-Cl) active against *Candida albicans* and compounds 9 (**R**=4-CH_3) and 13 (**R**=F) active against *Aspergillus niger*.

CONCLUSION

Current study describes the synthesis of novel series of 5-phenyl-3-(furan-2-yl)-4,5-dihydro-1H-pyrazole Derivatives. All synthesized compounds were characterized by spectral techniques such as IR, proton NMR. These newly compounds screened for *in vitro* for their antibacterial activity against *Bacillus subtilis, Staphylococcus aureus, Staphylococcus epidermis* (Gram-positive) *and Escherichia coli, Pseudomonas aeruginosa,* (Gram-negative) and antifungal activity against two fungal strains *Aspergillus niger* and *Candida albicans* by serial two-fold dilution method and the minimum inhibitory concentration (MIC) was determined. The result of antibacterial and antifungal activity showed that compound containing halogen groups or electron

withdrawing groups e.g., fluoro, nitro, chloro, bromo were found to be most active compounds amongst to all synthesized compounds. The compound 2 (**R**= NO_2) showed both antibacterial as well as antifungal activity.

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