A Facile Synthesis and Studies of Some New Chalcones and Their Derivatives Based on Heterocyclic Ring

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Received 01 November 2011; Accepted 07 January 2012

Abstract: Chalcones (**6a-f**) have been prepared by the condensation of ketone (**5**) and different aromatic and heterocyclic aldehydes. These chalcones (**6a-f**) on treatment with guanidine hydrochloride and phenyl hydrazine hydrochloride in presence of alkali give aminopyrimidines (**7a-f**) and phenylpyrazolines (**8a-f**) respectively. All the newly synthesized compounds have been characterized on the basis of IR, ¹H NMR spectral data as well as physical data. Antibacterial activity (minimum inhibitory concentration MIC) against Gram-positive *S. aureus* MTCC 96 and *S. pyogenes* MTCC 442 and Gram-negative *P. aeruginosa* MTCC 1688 and *E. coli* MTCC 443 bacteria, as well as antifungal activity (MIC) against *C. albicans* MTCC 227, *A. niger* MTCC 282 and *A. clavatus* MTCC 1323 were determined by broth dilution method.

Keywords: Chalcones, aminopyrimidines, phenyl pyrazolines, spectral data, antimicrobial activity.

Introduction

Commonly α , β - unsaturated ketone is known as chalcone. Chalcones^{1,2} are very reactive compounds and increase their reactivity due to keto-ethylinic type of conjugated double bond system present in the molecule. Chalcones have occupied unique place in medicinal and biological chemistry due to their diverse pharmacological properties such as anticancer³, anti-inflammatory⁴, antiviral⁵ and antibacterial⁶ etc.... Five membered heterocyclic like pyrazolines have found wide application as pharmaceutical and agrochemical agents. Pyrazoline derivatives have been found to possess wide range of therapeutic activities such as diuretic⁷, antifungal⁸, analgesic⁹, and molluscicidal¹⁰ etc.... Pyrimidine derivatives play a vital role in many biological processes and in synthesis of many drugs. Many pyrimidine derivatives have displayed diverse biological activities such as antitumor¹¹, hypnotensive¹², antiulcer¹³, and anticonvulsant¹⁴ etc...

In view of the above and in a continuation of our work¹⁵⁻¹⁷ on chalcones and its derivatives, we herein report a new series of chalcones (**6a-f**), aminopyrimidines (**7a-f**), and phenylpyrazolines (**8a-f**).

Experimental

All melting points were determined in open capillary and are uncorrected. The IR spectra were recorded on a FTIR - 8400 spectrometer. ¹H NMR spectra on a Bruker Avance DPX 400 MHz spectrometer with CDCl₃ as a solvent and tetramethylsilane (TMS) as internal standard. The chemical shifts are expressed in parts per million (ppm) downfield from the internal standard and signals are quoted as *s* (singlet) and *m* (multiplet). Analytical separation was conducted with silica Gel 60 F-254 (Merck) plates of 0.25 mm thickness eluted with toluene : acetone (10 : 2 v/v) and were visualized with UV (254 nm) or iodine to check the purity of the synthesized compounds.

Preparation of 2-(2', 4'-difluorophenylamino)-4, 6-dichloro-s-triazine (3)

2, 4-Difluoroaniline (0.01 mol, 1.29g in 10mL acetone) was added slowly to cyanuric chloride (0.01 mol, 1.845g in 30mL acetone) with constant stirring for 4 hours at 0 to 5°C. Periodically, sodium carbonate solution (0.005 mol, 0.53g in 10 mL water) was added drop wise to neutralized HCl evolved during the reaction. The progress of the reaction was monitored on TLC plate. Finally, the content was poured into crushed ice. The solid separated out was filtered, washed with water, dried and recrystallised from alcohol to give (**3**).

Preparation of 2, 4-bis-(2', 4'-difluorophenylamino)-6-chloro-s-triazine (4)

2,4-Difluoroaniline (0.01 mol, 1.29g in 10mL acetone) was added slowly to compound (**3**) (0.01 mol, 2.77g in 35mL acetone) with constant stirring for 6 hours at room temperature. Periodically, sodium carbonate solution (0.005 mol, 0.53g in 10mL water) was added drop wise to neutralized HCl evolved during the reaction. The progress of the reaction was monitored on TLC plate. Finally, the content was poured into crushed ice. The solid separated out was filtered, washed with water, dried and recrystallized from alcohol to give (**4**).

Preparation of 2,4-bis-(2',4'-difluorophenylamino)-6-(4'-acetylphenylamino)-s-triazine (5)

4-Aminoacetophenone (0.01 mol) and compound (**4**) (0.01 mol) were dissolved in acetone (40mL). The reaction mixture was refluxed for 8 hours. Periodically, sodium carbonate solution (0.005 mol, 0.53g in 10mL water) was added to neutralized HCl evolved during the reaction. The progress of the reaction was monitored on TLC plate. After completion the reaction the content was poured into crushed ice. The solid separated out was filtered, washed with water, dried and recrystallised from alcohol to give (**5**).

Preparation of 2,4-bis-(2',4'-difluorophenylamino)-6-[4'-(3"-methoxyphenyl)-2"-propenon-1"-yl} phenyl amino]-s-triazine (6a)

Compound (**5**) (0.01 mol) was dissolved in DMF (30mL) and 3-methoxybenzaldehyde (0.01 mol) was added to it. Then solution of KOH (5mL of 40%) was added to the reaction mixture with constant stirring at room temperature. The progress of the reaction was monitored on TLC plate. After completion the reaction mixture was poured into crushed ice

and neutralised with HCl. The product separated out was filtered, washed with water, dried and recrystallised from alcohol.

Similarly the remaining compounds (**6b-f**) were prepared by this method.

Compound (6a)

IR (KBr, cm^{-1}) : 3303 (N-H str.), 3072 (=CH str.), 1650 (C=O str.), 1508 (C=C str.), 1023 (C-O-C str.), 808 (C-N str., *s*-triazine moiety), 1085 cm^{-1} (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm) : 3.80 (3H, *s*, m-OCH₃), 6.41 (1H, *d*, -CO-CH=), 8.03 (1H, *d*, Ar-CH=), 6.98 – 7.90 (17H, *m*, Ar-H and -NH). Anal. Calcd. For C₃₁H₂₂F₄N₆O₂: C, 63.48; H, 3.78; N, 14.33. Found: C: 63.50; H: 3.80; N: 14.35%.

Compound (6b)

IR (KBr, cm^{-1}) : 3305 (N-H str.), 3075 (=CH str.), 1650 (C=O str.), 1517 (C=C str.), 1020 (C-O-C str.), 812 (C-N str., *s*-triazine moiety), 1082 cm^{-1} (C-F str.); ^1H NMR (CDCl_3 , δ , ppm) : 3.80 (6H, *s*, m-OCH₃), 3.83 (3H, *s*, p-OCH₃), 6.41 (1H, *d*, -CO-CH=), 8.05 (1H, *d*, Ar-CH=), 6.98 – 7.92 (15H, *m*, Ar-H and -NH). Anal. Calcd. For C₃₃H₂₆F₄N₆O₄: C, 61.30; H, 4.05; N, 13.00. Found: C: 61.28; H: 4.01; N: 12.98%.

Compound (6c)

IR (KBr, cm^{-1}) : 3303 (N-H str.), 3077 (=CH str.), 1652 (C=O str.) , 1510 (C=C str.), 1030 (C-O-C str.), 814 (C-N str., *s*-triazine moiety), 1083 cm^{-1} (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm) : 6.39 (1H, *d*, -CO-CH=), 8.03 (1H, *d*, Ar-CH=), 6.98 – 7.91 (22H, *m*, Ar-H and -NH). Anal. Calcd. For C₃₆H₂₄F₄N₆O₂: C, 66.66; H, 3.73; N, 12.96. Found: C: 66.65; H: 3.70; N: 12.94%.

Compound (6d)

IR (KBr, cm^{-1}): 3304 (N-H str.), 3070 (=CH str.), 1651 (C=O str.) , 1515 (C=C str.), 1545 (C-NO₂), 818 (C-N str., *s*-triazine moiety), 1084 cm^{-1} (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm) : 6.41 (1H, *d*, -CO-CH=), 8.03 (1H, *d*, Ar-CH=), 6.95 – 7.91 (17H, *m*, Ar-H and -NH). Anal. Calcd. For C₃₀H₁₉F₄N₇O₃: C, 59.90; H, 3.18; N, 16.30. Found : C: 59.87; H: 3.17; N: 16.28%.

Compound (6e)

IR (KBr, cm^{-1}) : 3310 (N-H str.), 3060 (=CH str.), 1653 (C=O str.) , 1505 (C=C str.), 820 (C-N str., *s*-triazine moiety), 595 (C-Br), 1087 cm^{-1} (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm): 6.44 (1H, *d*, -CO-CH=), 8.02 (1H, *d*, Ar-CH=), 6.95 – 7.91 (17H, *m*, Ar-H and -NH). Anal. Calcd. For C₃₀H₁₉F₄N₆OBr: C, 56.71; H, 3.01; N, 13.23. Found: C: 56.70; H: 3.00; N: 13.22%.

Compound (6f)

IR (KBr, cm^{-1}): 3308 (N-H str.), 3070 (=CH str.), 1655 (C=O str.) , 1517 (C=C str.), 1035 (C-O-C str.), 810 (C-N str., *s*-triazine moiety), 801 cm^{-1} (C-Cl str.) ; ^1H NMR (CDCl_3 , δ , ppm): 6.43 (1H, *d*, -CO-CH=), 8.03 (1H, *d*, Ar-CH=), 6.95 – 7.91 (16H, *m*, Ar-H and -NH). Anal. Calcd. For C₂₈H₁₈F₄N₆O₂: C, 61.54; H, 3.32; N, 15.38. Found: C: 61.50; H: 3.32; N: 15.35%.

Preparation of 2,4-bis-(2',4'-difluorophenylamino)-6-[4'-(2"-amino-6"-(3'''-methoxyphenyl)-pyrimidin-4"-yl)phenylamino]-s-triazine (7a)

Compound 6a (0.01 mol) was dissolved in ethyl alcohol (25mL) and guanidine hydrochloride (0.01 mol) was added to it. Then solution of KOH (5mL of 40%) was added to the reaction mixture and refluxed for 8 hours. The progress of the reaction was monitored on TLC plate. After completion the reaction mixture was cooled and poured into crushed ice and neutralised with dilute HCl. The product separated out was filtered, washed with water, dried and recrystallised from alcohol to give 7a.

Similarly the remaining compounds (**7b-f**) were prepared by this method.

Compound (7a)

IR (KBr, cm^{-1}): 3405 (N-H str.), 3065 (=CH str.), 809 (C-N str., *s*-triazine moiety), 825 (C-H bending), 1645 (C=N str, pyrimidine moiety), 1266 (C-O-C str.), 1095 (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm): 3.81 (3H, *s*, m-OCH₃), 5.1 (2H, *s*, -NH₂), 6.85 (1H, *s*, -CH=), 7.0 – 8.0 (17H, *m*, Ar-H and -NH). Anal. Calcd. For $\text{C}_{32}\text{H}_{23}\text{F}_4\text{N}_9\text{O}$: C, 61.44; H, 3.71; N, 20.15. Found : C: 61.42; H: 3.70; N: 20.10%.

Compound (7b)

IR (KBr, cm^{-1}): 3410 (N-H str.), 3070 (=CH str.), 810 (C-N str, *s*-triazine moiety), 830 (C-H bending), 1642 (C=N str, pyrimidine moiety), 1267 (C-O-C str), 1098 (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm): 3.81 (6H, *s*, m-OCH₃), 3.85 (3H, *s*, p-OCH₃), 5.2 (2H, *s*, -NH₂), 6.87 (1H, *s*, -CH=), 7.0 – 8.0 (15H, *m*, Ar-H and -NH). Anal. Calcd. For $\text{C}_{34}\text{H}_{27}\text{F}_4\text{N}_9\text{O}_3$: C, 59.56; H, 3.97; N, 18.39. Found: C, 59.52; H, 3.95; N, 18.35%.

Compound (7c)

IR (KBr, cm^{-1}): 3412 (N-H str.), 3072 (=CH str.), 812 (C-N str., *s*-triazine moiety), 832 (C-H bending), 1641 (C=N str, pyrimidine moiety), 1270 (C-O-C str.), 1098 (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm): 5.3 (2H, *s*, -NH₂), 6.83 (1H, *s*, -CH=), 7.0 – 8.0 (22H, *m*, Ar-H and -NH). Anal. Calcd. For $\text{C}_{37}\text{H}_{25}\text{F}_4\text{N}_9\text{O}$: C, 64.63; H, 3.66; N, 18.33. Found: C: 64.60; H, 3.64; N, 18.30%.

Compound (7d)

IR (KBr, cm^{-1}): 3410 (N-H str.), 3071 (=CH str.), 815 (C-N str, *s*-triazine moiety), 830 (C-H bending), 1550 (C-NO₂), 1644 (C=N str, pyrimidine- moiety), 1087 (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm): 5.1 (2H, *s*, -NH₂), 6.81 (1H, *s*, -CH=), 7.0 – 8.0 (17H, *m*, Ar-H and -NH). Anal. Calcd. For $\text{C}_{31}\text{H}_{20}\text{F}_4\text{N}_{10}\text{O}_2$: C, 58.13; H, 3.15; N, 21.87. Found: C: 58.11; H: 3.12; N: 21.85%.

Compound (7e)

IR (KBr, cm^{-1}): 3410 (N-H str.), 3072 (=CH str.), 816 (C-N str, *s*-triazine moiety), 832 (C-H bending), 1646 (C=N str, pyrimidinemoiety), 605 (C-Br), 1087 (C-F str.) ; ^1H NMR (CDCl_3 , δ , ppm): 5.2 (2H, *s*, -NH₂), 6.82 (1H, *s*, -CH=), 7.1 – 8.1 (17H, *m*, Ar-H and -NH). Anal. Calcd. For $\text{C}_{31}\text{H}_{20}\text{F}_4\text{N}_9\text{Br}$: C, 55.21; H, 2.99; N, 18.69. Found : C: 55.19; H, 2.95; N, 18.65%.

Compound (7f)

IR (KBr, cm^{-1}) : 3413 (N-H str.), 3074 (=CH str.), 818 (C-N str, *s*-triazine moiety), 835 (C-H bending), 1643 (C=N str, pyrimidine moiety), 1271 (C-O-C str.), 1087 (C-F str.); ^1H NMR (CDCl_3 , δ , ppm): 5.3 (2H, *s*, -NH₂), 6.85 (1H, *s*, -CH=), 7.1 – 8.1 (16H, *m*, Ar-H and -NH). Anal. Calcd. For $\text{C}_{29}\text{H}_{19}\text{F}_4\text{N}_9\text{O}$: C, 59.49; H, 3.27; N, 21.53. Found: C: 59.45; H, 3.26; N, 21.50%.

Preparation of 2,4-bis-(2',4'-difluorophenylamino)-6--[4'-{1''-phenyl-5''-(3'''-methoxyphenyl)-2''-pyrazolin-3'''-yl} phenylamino]-s-triazine (8a)

Compound 6a (0.01 mol) was dissolved in alcohol (25mL) and phenyl hydrazine hydrochloride (0.01 mol, 1.44 g) in 40 mL alcohol was refluxed for 10 hours in the presence of 40 % KOH (3mL). The progress of the reaction was monitored on TLC plate. After completion the reaction mixture was cooled and poured into crushed ice and neutralized with dilute HCl. The product separated out was filtered, washed with water, dried and recrystallised from alcohol to give 8a.

Similarly the remaining compounds (**8b-f**) were prepared by this method.

Compound (8a)

IR (KBr, cm^{-1}): 3402 (N-H str.), 3060 (=CH str.), 809 (C-N str, *s*-triazine moiety), 1574 (C=N str, pyrazoline moiety), 2985 (C-H str, pyrazoline moiety), 1095 (C-F str.); ^1H NMR (CDCl_3 , δ , ppm): 3.0 (1H, *dd*, -CHa-CH), 3.2 (1H, *dd*, -CHb-CH), 3.8 (3H, *s*, *m*- OCH_3), 7.0 – 8.0 (22H, *m*, Ar-H and -NH), 5.3 (1H, *t*, -CH- CH_2 -Ar-). Anal. Calcd. For $\text{C}_{37}\text{H}_{28}\text{F}_4\text{N}_8\text{O}$: C, 65.68; H, 4.17; N, 16.56. Found: C: 65.65; H: 4.15; N: 16.50%.

Compound (8b)

IR (KBr, cm^{-1}): 3404 (N-H str.), 3065 (=CH str.), 811 (C-N str, *s*-triazine moiety), 1575 (C=N str., pyrazoline moiety), 2987 (C-H str., pyrazoline moiety), 1270 (C-O-C str.), 1090 (C-F str.); ^1H NMR (CDCl_3 , δ , ppm): 3.1 (1H, *dd*, -CHa-CH), 3.3 (1H, *dd*, -CHb-CH), 3.4 (6H, *s*, *m*- OCH_3), 3.6 (3H, *s*, *p*- OCH_3), 7.0 – 8.0 (21H, *m*, Ar-H and -NH), 5.2 (1H, *t*, -CH- CH_2 -Ar-). Anal. Calcd. For $\text{C}_{39}\text{H}_{32}\text{F}_4\text{N}_8\text{O}_3$: C, 63.58; H, 4.38; N, 15.21. Found: C: 63.56; H, 4.35; N, 15.18%.

Compound (8c)

IR (KBr, cm^{-1}): 3405 (N-H str.), 3065 (=CH str.), 810 (C-N str, *s*-triazine moiety), 1575 (C=N str, pyrazoline moiety), 2983 (C-H str, pyrazoline moiety), 1097 (C-F str.); ^1H NMR (CDCl_3 , δ , ppm): 3.2 (1H, *dd*, -CHa-CH), 3.3 (1H, *dd*, -CHb-CH), 7.0 – 8.0 (27H, *m*, Ar-H and -NH), 5.4 (1H, *t*, -CH- CH_2 -Ar-). Anal. Calcd. For $\text{C}_{42}\text{H}_{30}\text{F}_4\text{N}_8\text{O}$: C, 68.29; H, 4.09; N, 15.17. Found: C: 68.26; H, 4.05; N, 15.15%.

Compound (8d)

IR (KBr, cm^{-1}): 3406 (N-H str.), 3066 (=CH str.), 809 (C-N str, *s*-triazine moiety), 1540 (C- NO_2), 1578 (C=N str, pyrazoline moiety), 2987 (C-H str, pyrazoline moiety), 1096 (C-F str.); ^1H NMR (CDCl_3 , δ , ppm): 3.0 (1H, *dd*, -CHa-CH), 3.3 (1H, *dd*, -CHb-CH), 7.1 – 8.1 (22H, *m*, Ar-H and -NH), 5.5 (1H, *t*, -CH- CH_2 -Ar-). Anal. Calcd. For $\text{C}_{36}\text{H}_{25}\text{F}_4\text{N}_9\text{O}_2$: C, 62.52; H, 3.64; N, 18.23. Found: C: 62.50; H: 3.62; N: 18.20%.

Compound (8e)

IR (KBr, cm^{-1}): 3407 (N-H str.), 3070 (=CH str.), 813 (C-N str, *s*-triazine moiety), 1580 (C=N str, pyrazoline moiety), 2987 (C-H str, pyrazoline moiety), 1098 (C-F str.), 595 (C-Br); ^1H NMR (CDCl_3 , δ , ppm): 3.1 (1H, *dd*, -CHa-CH), 3.3 (1H, *dd*, -CHb-CH), 7.2 – 8.2 (22H, *m*, Ar-H and -NH), 5.5 (1H, *t*, -CH- CH_2 -Ar-). Anal. Calcd. For $\text{C}_{36}\text{H}_{25}\text{F}_4\text{N}_8\text{Br}$: C, 59.60; H, 3.47; N, 15.44. Found: C: 59.58; H, 3.45; N, 15.42%.

Compound (8f)

IR (KBr, cm^{-1}): 3408 (N-H str.), 3068 (=CH str.), 811 (C-N str, *s*-triazine moiety), 1578 (C=N str, pyrazoline moiety), 2987 (C-H str, pyrazoline moiety), 1265 (C-O-C str.), 1096 (C-F str.); ^1H NMR (CDCl_3 , δ , ppm): 3.0 (1H, *dd*, -CHa-CH), 3.1 (1H, *dd*, -CHb-CH), 7.3 – 8.3 (21H, *m*, Ar-H and -NH), 5.5 (1H, *t*, -CH- CH_2 -Ar-). Anal. Calcd. For $\text{C}_{34}\text{H}_{24}\text{F}_4\text{N}_8\text{O}$: C, 64.15; H, 3.80; N, 17.60. Found: C: 64.12; H, 3.78; N, 17.58%.

Results and Discussion

The *in vitro* antibacterial and antifungal activities of the compounds are shown in (Table 2). The MICs ($\mu\text{g/mL}$) were carried out by broth microdilution method as described by Rattan¹⁸. The newly synthesised compounds (6a-f), (7a-f) and (8a-f) were screened for their antibacterial activity against two Gram positive bacteria strains: *S. aureus* MTCC96 and *S. pyogenes* MTCC442 and two Gram negative bacteria *E. coli* MTCC443 and *P. aeruginosa* MTCC1688 and compared with standard drug: Ampicillin and Antifungal activity against *C. albicans* MTCC227, *A. niger* MTCC282 and *A. clavatus* MTCC1323 organisms was determined by same method and compared with standard drug: Griseofulvin.

SCHEME

Table 1. Characterization data of compounds (6a-f), (7a-f) and (8a-f).

Compds	R	M.P. °C	% Yield
6a	3-Methoxyphenyl	99	72
6b	3,4,5-Trimethoxyphenyl	112	69
6c	3-Phenoxyphenyl	103	76
6d	3-Nitrophenyl	153	69
6e	3-Bromophenyl	102	56
6f	2-Furanyl	113	72
7a	3-Methoxyphenyl	129	63
7b	3,4,5-Trimethoxyphenyl	122	71
7c	3-Phenoxyphenyl	158	60
7d	3-Nitrophenyl	193	69
7e	3-Bromophenyl	180	67
7f	2-Furanyl	131	51
8a	3-Methoxyphenyl	125	69
8b	3,4,5-Trimethoxyphenyl	185	66
8c	3-Phenoxyphenyl	131	64
8d	3-Nitrophenyl	245	73
8e	3-Bromophenyl	117	59
8f	2-Furanyl	135	61

Antibacterial Activity

From the screening results (Table – 2), The result shows that compounds **6c** , **6d** , **6e** , **7c** , **8a** , **8c** and **8f** exhibited good activity (25 – 125 µg/mL) against *E. coli* ; compound **8e** exhibited good activity (50 – 100 µg/mL) against *P. aeruginosa* . In Gram positive bacterial strains compounds **6b** , **6f** , **7a** , **8b** , **8c** and **8d** showed good to very good activity (25 – 150 µg/mL) against *S. aureus* ; whereas compound **7a** showed good activity (62.5 – 100 µg/mL) against *S. pyogenes* compared with Ampicillin. All others compounds show moderately active or less active against all bacterial strains.

Antifungal Activity

From the screening results (Table – 2), Compounds **6a** , **6b** , **7b** , **7c** , **7e** , **8a** and **8b** showed good activity against *C. albicans* compared with Griseofulvin, while compounds **6f** and **8c** showed very good activity against *C. albicans*.

Conclusion

Compounds having methoxy and phenoxy groups have exhibited more antimicrobial activity. These results suggest that the chalcone derivatives have excellent scope for further development as commercial antimicrobial agents. Further experiments were needed to elucidate their mechanism of action.

Table 2. Antibacterial and antifungal activity data of compounds 6(a-f), 7(a-f) and 8(a-f).

Comps	Minimal bactericidal concentration μg/mL				Minimal fungicidal concentration μg/mL		
	Gram negative		Gram positive				
	E. coli MTCC- 443	P. aerug MTCC- 1688	S. aureus MTCC- 96	S. pyogenus MTCC- 442	C. albicans MTCC- 227	A. niger MTCC- 282	A. clavatus MTCC- 1323
6a	500	200	200	250	500	500	500
6b	200	200	125	125	500	>1000	>1000
6c	125	200	500	250	1000	250	500
6d	125	250	250	250	1000	1000	1000
6e	100	125	500	500	1000	500	1000
6f	500	250	100	125	200	1000	1000
7 ^a	250	200	125	100	1000	500	500
7b	200	125	250	250	500	>1000	>1000
7c	125	200	250	200	500	>1000	>1000
7d	200	250	200	250	1000	500	500
7e	250	250	200	250	500	1000	1000
7f	250	250	500	250	>1000	>1000	>1000
8a	125	200	250	125	500	500	500
8b	200	250	125	125	500	>1000	>1000
8c	100	250	125	250	250	500	500
8d	500	500	125	200	>1000	>1000	>1000
8e	200	100	500	250	>1000	250	500
8f	100	125	250	500	1000	1000	1000
Ampicillin	100	100	250	100	-	-	-
Griseofulvin	-	-	-		500	100	100

Acknowledgment

We are grateful to B. K. M. Science College, Valsad for providing research facilities, Atul Ltd. (Atul) for the IR spectral analysis, RSIC Punjab University for the ¹H NMR spectral analysis and D. Rajani, Microcare Laboratory, Surat, for antimicrobial activity screening.

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