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SYNTHESIS AND SCREENING OF SOME NOVEL CHALCONE DERIVATIVES CONTAINING FURAN RING AS POTENTIAL ANTIMICROBIAL AGENTS

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ABSTRACT

Chalcones are a category of natural products which posses a wide variety of biological activities. Keeping in mind the diverse array of biological activities associated with chalcones a series of some new chalcones containing different substituents were synthesized by Claisen-Schmidt condensation of 2-acetyl-5-bromofuran with various substituted aromatic and heteroaromatic aldehydes. The synthesized chalcones were purified by recrystallization and column chromatography. The characterization of the purified chalcones was made by IR, ^{1}H NMR and elemental analysis data. These compounds were further screened for their antimicrobial activity. When these chalcones were evaluated for antibacterial and antifungal activities, some of them found to possess significant biological activity when compared to standard drugs.

KEYWORDS: Chalcone, Claisen-Schmidt condensation, Antimicrobial activity.

INTRODUCTION

Chalcone is a generic term given to compounds bearing the 1,3-diphenylprop-2-en-1-one frame work, which can be functionalized in the propane chain by the presence of olefinic and keto groups (Figure 1).[1] Chalcones are abundantly present in nature starting from ferns to higher plants.[2] Chalcones are readily synthesized by the base catalyzed Claisen-Schmidt condensation of an aldehyde and an appropriate ketone in a polar solvent like ethanol and yields may be variable,[3, 4] ranging from 5 to 80 %. The chalcones have a diverse range of biological activities, some of which include antiulcerative, [5] anti-viral and anti-malarial, [6]

anti-bacterial, [7] anti-HIV, [8] anti-leishmanial, antitubercular, anti-hyperglycemic, analgesic and anti-inflammatory [9, 10, 11] and anti-fungal activities. [12-16]

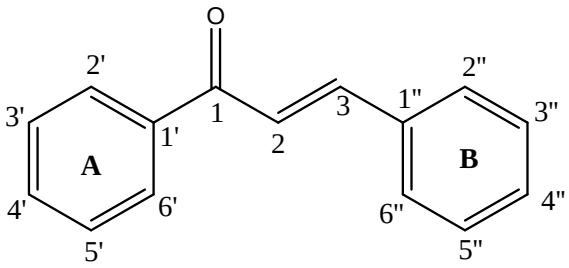


Fig 1 General structure of Chalcones

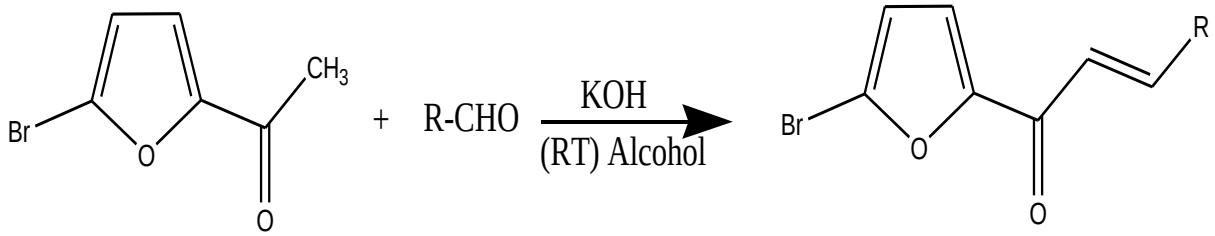
In the present communication, we report the reaction of 2-acetyl-5-bromofuran with different aromatic/heteroaromatic aldehydes to form chalcones (**C-1 to C-17**). The structures of various synthesized chalcones were characterized on the basis of elemental analyses, IR and ^{1}H NMR spectral data. The compounds were evaluated for their antimicrobial activity by cup plate method**.**

MATERIALS AND METHODS

Melting points were determined in an open capillary melting point apparatus and are uncorrected. ^{1}H NMR was recorded in CDCl3 on Bruker WM 400 MHz spectrometer with TMS as internal standard. Infrared spectra were recorded (KBr) on Perkin-Elmer AC-1 spectrophotometer. Microanalyses were performed on Carloerba EA-1108 element analyzer and were within the ± 0.4 % of the theoretical values. Reaction completion was identified by TLC using Silica gel-G for TLC (Merck). All the chalcones have been purified by column chromatography performed on Silica gel (100-200 mesh, Merck).

General procedure for the preparation of Chalcones

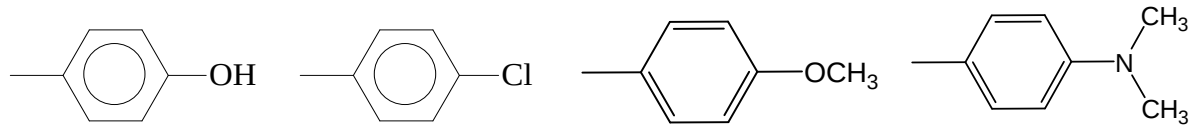
A mixture of 2-acetyl-5-bromofuran (0.005M) and various substituted aromatic/ heteroaromatic aldehydes (0.005M) were stirred in ethanol (30 ml) manually at room temperature for 10 minutes, kept and then an aqueous solution of 50% potassium hydroxide (7.5 ml) was added to it. The mixture was kept overnight at room temperature and then it was poured into crushed ice and acidified with dilute hydrochloric acid. The chalcone derivatives precipitated out as solid. Then it was filtered and recrystallized from ethanol **(Scheme 1)**. This procedure remained same with all types of aldehydes.



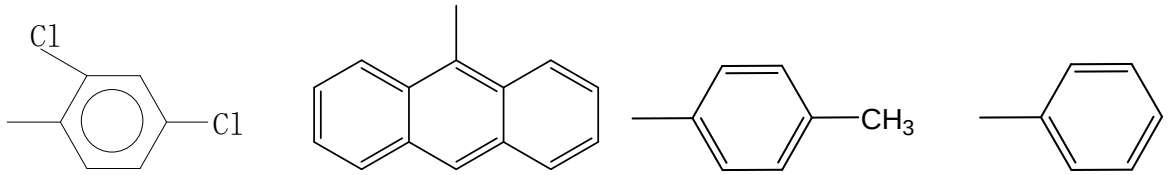
2-acetyl-5-bromofuran Aromatic/ Heteroaromatic Aldehyde Chalcone derivative

Scheme 1

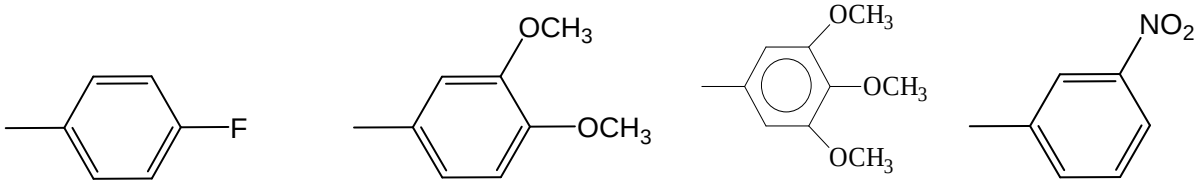
R



C-1 **C-2** **C-3** **C-4**

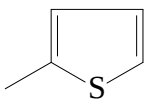


C-5 **C-6** **C-7** **C-8**



C-9 **C-10** **C-11** **C-12**

C-13 **C-14** **C-15** **C-16**



C-17

The list of new chalcones (C-1 to C-17) synthesized are

1. 1-(5'-bromo-2'-furyl)-3-(4''-hydroxyphenyl)-2-propen-1-one (C-1)
2. 1-(5'-bromo-2'- furyl)-3-(4''-chlorophenyl)-2-propen-1-one (C-2)
3. 1-(5'-bromo-2'- furyl)-3-(4''-methoxyphenyl)-2-propen-1-one (C-3)

4. 1-(5'-bromo-2'- furyl)-3-(4''-dimethylaminophenyl)-2-propen-1-one(C-4)
5. 1-(5'-bromo-2'- furyl)-3-(2'',4''-dichlorophenyl)-2-propen-1-one (C-5)
6. 1-(5'-bromo-2'- furyl)-9''-anthryl-2-propen-1-one (C-6)
7. 1-(5'-bromo-2'- furyl)-3-(4''-methylphenyl)-2-propen-1-one (C-7)
8. 1-(5'-bromo-2'- furyl)-3-phenyl-2-propen-1-one (C-8)
9. 1-(5'-bromo-2'- furyl)-3-(4''-fluorophenyl)-2-propen-1-one (C-9)
10. 1-(5'-bromo-2'- furyl)-3-(3'',4''-dimethoxyphenyl)-2-propen-1-one (C-10)
11. 1-(5'-bromo-2'- furyl)-3-(3'',4'',5''-trimethoxyphenyl)-2-propen-1-one(C-11)
12. 1-(5'-bromo-2'- furyl)-3-(3''-nitrophenyl)-2-propen-1-one (C-12)
13. 1-(5'-bromo-2'- furyl)-3-(4''-nitrophenyl)-2-propen-1-one (C-13)
14. 1-(5'-bromo-2'- furyl)-3-(3''-pyridinyl)-2-propen-1-one (C-14)
15. 1-(5'-bromo-2'- furyl)-3-(4''-pyridinyl)-2-propen-1-one (C-15)
16. 1-(5'-bromo-2'- furyl)-3-(2''-pyrrolyl)-2-propen-1-one (C-16)
17. 1-(5'-bromo-2'- furyl)-3-(2''-thienyl)-2-propen-1-one (C-17)

Table 1. Physical characterization data of the prepared chalcones (C-1-C-17)

Compound	Molecular formula	Relative molecular mass (RMM)	Melting Point (^{0}C)	Yield (%)
C-1	$C_{13}H_9BrO_3$	293	188	88
C-2	$C_{13}H_8ClBrO_2$	311	123	93
C-3	$C_{14}H_{11}BrO_3$	307	79	89
C-4	$C_{15}H_{14}NBrO_2$	320	122	89
C-5	$C_{13}H_7Cl_2BrO_2$	346	99	93
C-6	$C_{21}H_{15}BrO_2$	377	168	80
C-7	$C_{14}H_{11}BrO_2$	291	111	96
C-8	$C_{13}H_9BrO_2$	277	92	78
C-9	$C_{13}H_8FBrO_2$	295	88	95
C-10	$C_{15}H_{13}BrO_4$	337	109	79
C-11	$C_{16}H_{15}BrO_5$	367	143	90
C -12	$C_{13}H_8NBrO_4$	322	161	80
C -13	$C_{13}H_8NBrO_4$	322	211	73
C-15	$C_{12}H_8NBrO_2$	278	211	59
C-16	$C_{12}H_8NBrO_2$	278	192	77
C-17	$C_{11}H_7BrO_2S$	283	85	84

Table 2. Elemental Analysis data of chalcones (C-1 - C-17)

Compound	Calculated (%)			Found (%)		
	C	H	N	C	H	N
C-1	51.48	2.99	---	50.18	2.77	----
C-2	47.70	2.44	---	47.50	2.24	----
C-3	52.01	3.40	---	52.00	3.20	----
C-4	53.57	4.16	4.16	53.36	4.06	4.11
C-5	43.21	1.93	---	43.01	1.73	----
C-6	63.79	3.79	---	63.59	3.59	----
C-7	54.72	3.58	---	54.52	3.38	----
C-8	53.24	3.07	---	53.04	3.02	----
C-9	50.16	2.57	---	50.11	2.37	----
C-10	50.99	3.68	---	50.79	3.48	----
C-11	50.13	3.91	---	50.02	3.71	----
C-12	46.15	2.36	4.14	46.05	2.16	4.08
C-13	46.15	2.36	4.14	46.08	2.16	4.09
C-14	48.97	2.72	4.76	48.77	2.52	4.56
C-15	48.97	2.72	4.76	48.77	2.52	4.46
C-16	46.80	2.83	4.96	46.60	2.63	4.76
C17	46.66	2.34	---	44.11	2.14	----

Table 3. IR and ^{1}H NMR spectral data of the prepared compounds

Compd.	IR (ν max cm^{-1})	^{1}H NMR (CDCl3), δ ppm
C-1	3625 (OH), 1654 (C=O), 1582 (C=C quadrant of Ar), 1509 (CH=CH),1150 (C-O), 670 (C-Br)	7.28(1H, d, J=17 Hz, -CO-CH=), 7.81 (1H, d, J=17 Hz, =CH-Ar), 5.56 (1H, s, Ar-OH, D2O exchangeable), 7.65 (1H, d, J=6.5 Hz, C-3'-H) 7.17 (1H, d, J=7.0 Hz, C-4'-H), 7.55 (2H, d, J=7 Hz, C-2"and 6"-H), 6.88 (2H, dd, J=7 Hz , C-3" and 5"-H)
C-2	1645 (C=O), 1585 (C=C quadrant of Ar), 1520 (CH=CH), 850 (C-Cl) 1100 (C-O), 660 (C-Br)	7.69 (1H, d, J=17 Hz, -CO-CH=), 7.87 (1H, d, J=17 Hz, =CH-Ar), 7.37 (1H, d, J=6.5 Hz, C-3'-H), 7.19 (1H, d, J=7.0 Hz, C-4'-H), 7.57 (2H, d, J=7Hz, C-2"-H and -C-6"-H), 7.39 (2H, dd, J=7 Hz, C-3"-H and C-5"-H)
C-3	1640 (C=O), 1580 (C=C quadrant of Ar), 1516 (CH=CH),1170 (-O-CH3), 1093 (C-O), 672 (C-Br)	6.93 (1H, d, J=17 Hz, -CO-CH=), 7.60 (1H, d , J=17 Hz, =CH-Ar), 7.85 (1H, d, J=6.5, C-3'-H), 7.17 (1H, d, J=7.0 Hz, C-4'-H), 7.67 (2H, d, J=7 Hz, -C-2"-H and -C-6"-H), 6.91 (2H, d, J=7 Hz , C-3"-H and -C-5"-H)
C-4	1650 (C=O), 1583 (C=C quadrant of Ar), 1520 (CH=CH) ,1180 (N(CH3)2), 1212 (C-O), 678 (C-Br)	6.69 (1H, d, J=17 Hz, -CO-CH=), 7.54 (1H, d, J=17 Hz, =CH-Ar), 3.04 (1H, s, N(CH3)2), 7.16 (1H, d, J=7.0 Hz, C-4'-H), 7.85 (1H, d, J=6.5 Hz, C-3'-H), 7.81 (2H, d, J=7 Hz, C-2"-H and C-6"-H), 7.62 (2H, d, J=7 Hz, C-3"-H and C-5"-H)
C-5	1645 (C=O), 1580 (C=C quadrant of Ar), 1520 (CH=CH), 855(C-Cl) 1188 (C-O), 680 (C-Br)	7.30 (1H, d, J=17 Hz, -CO-CH=), 7.86 (1H, d, J=17 Hz, =CH-Ar), 7.68 (1H, d, J=6.5 Hz, -C-3'-H), 7.19 (1H, d, J=7.0 Hz, -C-4'-H), 7.47 (1H, s, -C-3"-H), 7.66 (1H, d, J=7 Hz, -C-5"-H), 7.70 (1H, d, J=7 Hz, -C-6"-H)
C-6	1645 (C=O), 1580 (C=C quadrant of Ar), 1520(CH=CH), 1145 (C-	7.43 (1H, d, J=17 Hz, -CO-CH=), 7.73 (1H, d, J=17 Hz, =CH-Ar), 8.05 (1H, d, J=6.5 Hz, C-3'-H), 8.08 (1H, d, J=7.0 Hz, C-4'-H), 7.17-7.78 (10H, Ar-H)

	O),650 (C-Br)	
C-7	1650 (C=O), 1580 (C=C quadrant of Ar), 1515 (CH=CH), 1152 (C-O) , 662 (C-Br)	7.38 (1H, d, J=17 Hz,-CO-CH=),7.55 (1H, d, J=17 Hz, =CH-Ar), 7.57 (1H, d, J=6.5 Hz, -C-3'-H), 7.18 (1H, d, J=7.0Hz, -C-4'-H), 7.67 (2H, d, J=8 Hz, -C-2"-H and -C-6"-H), 7.22 (2H, d, J=6.5 Hz, -C-3"-H and -C-5"-H)
C-8	1650 (C=O), 1582 (C=C quadrant of Ar), 1520 (CH=CH), 1088 (C-O), 660 (C-Br)	7.68 (1H, d, J=17 Hz, -CO-CH=), 7.83 (1H, d, J=17 Hz, =CH-Ar), 7.41 (1H, d, J=6.5 Hz, C-3'-H,), 7.18 (1H, d, J=7.0 Hz, C-4'-H), 7.63 (2H, m, C-2"-H and C-6"-H), 7.39 (3H, m, C-3"-H, C-4"-H and C-5"-H)
C-9	1650 (C=O), 1570 (C=C quadrant of Ar), 1520 (CH=CH), 1120 (C-F), 1115 (C-O), 662 (C-Br)	7.33 (1H, d, J=17 Hz, -CO-CH=), 7.80 (1H, d, J=17 Hz, =CH-Ar),7.67 (1H, d, J=6.5 Hz, C-3'-H), 7.18 (1H, d, J=7.0 Hz, C-4'-H), 7.62 (2H,d, J=8 Hz, C-2" and 6"-H), 7.10 (2H, d, J=8 Hz, C-3" and 5"-H)
C-10	1641 (C=O), 1579 (C=C quadrant of Ar) , 1510 (CH=CH), 1141 (-O-CH3), 1157 (C-O), 678 (C-Br)	6.89 (1H, d, J=17 Hz, -CO-CH=), 7.80 (1H, d, J=17 Hz, =CH-Ar), 7.65 (1H, d, J=6.5 Hz, C-3'-H), 7.16 (1H, d, J=7.0 Hz, C-4'-H), 7.24 (1H, s, C-2"-H), 3.92-3.94 (6H, 2 x -OCH3), 7.13 (1H, d, J=7 Hz, C-5"-H), 7.29 (1H, d, J=7 Hz, C-6"-H)
C-11	1640 (C=O), 1580 (C=C quadrant of Ar), 1520 (CH=CH), 1175 (-O-CH3), 1086 (C-O), 648 (C-Br)	7.68 (1H, d, J=17 Hz, -CO-CH=), 7.88 (1H, d, J=17 Hz, =CH-Ar), 3.89-3.94 (9H, s, 3X-OCH3), 7.77 (1H, d, J=6.5 Hz, C-3'-H), 7.19 (1H, d, J=7.0 Hz, C-4'-H), 7.27 (2H, s, C-2"-H and C-6"-H)
C-12	1650 (C=O) ,1593 (C=C quadrant of Ar) ,1519 (N=O,asymmetric), 1337 (N=O, symmetric), 1060 (C-O), 658 (C-Br)	7.51 (1H, d, J=17 Hz, -CO-CH=), 7.87 (1H, d, J=17 Hz, =CH-Ar), 7.61 (1H, d, J=6.5 Hz, C-3'-H), 7.21 (1H, d, J=7.0 Hz, C-4'H), 8.50 (1H, d, J=2 Hz, C-2''-H), 8.25 (1H, m, C-4"-H), 7.90 (2H, m, C- 5"-H and C-6"-H)
C-13	1650 (C=O),1577 (C=C quadrant of Ar), 1510 (CH=CH),1510 (N=O, asymmetric), 1320 (N=O, symmetric), 1097 (C-O), 648 (C-Br)	7.50 (1H, d, J=17 Hz, -CO-CH=), 7.85 (1H, d, J=15.6 Hz, =CH-Ar), 7.73 (1H, d, J=6.5 Hz, C-3'-H), 7.21 (1H, d, J=7.0 Hz, C-4'-H),7.78 (2H, d, J=7 Hz, C-2" and 6"-H), 8.27 (2H,d, J=7 Hz, C-3" and 5"-H)
C-14	1658 (C=O), 1520 (C=C quadrant of Ar), 1585 (C=N), 1119 (C-O),642 (C-Br)	6.81 (1H, d, J=17 Hz,-CO-CH=), 7.14 (1H, d, J=17 Hz, =CH-Ar), 6.91 (1H, d, C-3'-H), 6.66 (1H, d, J=7.0 Hz, C-4'-H), 8.60 (2H, d, J=7 Hz, C-2"-H and C-6"-H), 7.05 (2H, dd, C-3"-H and C- 4"-H)
C-15	1655 (C=O),1515 (C=C quadrant of Ar),1590 (C=N), 1066 (C-O), 654 (C-Br)	6.81 (1H, d, J=17 Hz,-CO-CH=), 7.06 (1H, d, J=17 Hz, =CH-Ar), 7.37 (1H, d, J=6 Hz, C-3'-H), 6.92 (1H, d, J=7.0 Hz, C-4'-H), 8.16 (2H, d, J=7 Hz, C-2"-H and C-6"-H), 8.33 (2H, d, J=7 Hz, C-3"-H and C-5"-H)
C-16	1653 (C=O), 1235 (-C=N), 3350 (-NH), 1132 (C-O), 658 (C-Br)	6.32 (1H, d ,J=17 Hz, -CO-CH=), 7.02 (1H, d, J=17.2 Hz, =CH-Ar), 7.62 (1H, d, J=7 Hz, C-3'-H) , 7.14 (1H, d, J=7.0 Hz, C-4'-H), 7.78 (3H, m, C-3",4"and C-5"-H)
C-17	1650 (C=O), 1575 (C=C quadrant of Ar), 1520 (-CH=CH), 1059 (C-O), 656 (C-Br)	7.20 (1H,d, J= 17 Hz , -CO-CH=), 7.95 (1H, d, J=17 Hz, =CH-Ar), 7.49 (2H, d, J=6.5 Hz,C-3'-H and C-3"-H), 7.14 (2H, d, J=7.0 Hz, C-4'-H and C-4"-H), 7.38 (1H,d, J=6.5 Hz, C-5"-H)

ANTIMICROBIAL STUDIES[17]

Since the chalcones were reported to possess antimicrobial activity, the chalcones prepared during the course of the present work were tested for antibacterial and antifungal activity.

A. Antibacterial Activity

The antibacterial activity was tested by cup-plate method and compared with the standard (benzylpencillin) at a concentration of 1000 µg/ml. Dimethyl sulfoxide (DMSO) was used as a solvent and control. The following organisms were used.

Test organisms

Gram positive bacteria: *Bacillus pumilus Bacillus subtilis*

Gram negative bacteria

Escherichia coli

Proteus vulgaris

B. Antifungal activity

The antifungal activity was tested by the same procedure as described in the antibacterial activity, except using a different medium. The antifungal activity of chalcones were tested and compared with the standard (fluconazole) at a concentration of 1000 µg/ml. The following organisms were used.

- *Aspergillus niger Pencillium chrysogenium.*

Antibacterial activity: Experimental procedure

Nutrient agar (Hi-media) was dissolved and distributed in 25 ml quantities in 100 ml conical flasks and were sterilized in an autoclave at 121 ^{0}C (15 lbs/sq.in) for 20 minutes. The medium was inoculated at one percent level using 18 hrs old cultures of the test organism mentioned above, aseptically into sterile petridishes and allowed to set at room temperature for about 30 minutes. In a size of 4 inch petridishes, four cups of 8mm diameter at equal distance were made in each plate. In each plate, one cup was used for control i.e. Dimethyl sulfoxide (DMSO), another for standard benzylpencillin and all the test compounds and the standard were tested at 50 µg and 100 µg dose levels. The plates thus prepared were left for 90 minutes in a refrigerator for diffusion. After incubation for 24 hours at 37 ^{0}C ± 1 ^{0}C, the plates were examined for inhibition zones. The experiments were performed in duplicate and the average diameter of the zones of inhibition measured were recorded.

Antifungal activity: Experimental procedure

Potato-dextrose-agar (Hi-media) was dissolved and distributed in 25 ml quantities in 100 ml conical flasks and were sterilized in an autoclave at 121^0C (15 lbs/sq.in) for 20 minutes. The medium was inoculated at one percent level using 48 hrs old cultures of the test organism mentioned above aseptically into sterile petridishes and allowed to set at room temperature for about 30 minutes. In 4 inch petridishes, four cups of 8 mm diameter at equal distance were made in each plate. In each plate, one cup was used for control i.e. Dimethyl sulfoxide (DMSO), another for standard fluconazole. Each compound was tested at two different dose levels (50 µg and 100 µg). The plates thus prepared were left for 90 minutes in a refrigerator for diffusion. After incubation for 48 hours at 25 ^{0}C, the plates were examined for inhibition zones. The experiments were performed in duplicate and the average diameters of the zones of inhibition measured were recorded.

Table 4. Antibacterial activity of chalcones (C-1 to C-17)

Compound	Zone of inhibition (in mm)							
	B.subtilis		***B.pumilis***		***E.coli***		***P.vulgaris***	
	50 µg	**100 µg**	**50 µg**	**100 µg**	**50 µg**	**100 µg**	**50 µg**	**100 µg**
Standard	29	34	32	33	26	28	29	32
Control	-	-	-	-	-	-	-	-
C-1	11	12	10	11	09	10	08	07
C-2	14	15	12	13	13	12	14	15
C-3	12	13	11	12	12	13	14	13
C-4	17	18	13	16	18	19	17	18
C-5	13	14	13	15	14	15	10	11
C-6	15	16	11	12	12	14	11	13
C-7	07	09	08	09	07	08	06	07
C-8	09	10	07	09	07	08	04	08
C-9	15	16	09	15	16	18	12	16
C-10	14	21	15	17	14	22	11	18
C-11	16	19	16	23	17	18	18	19
C-12	13	15	15	20	13	16	14	20
C-13	18	19	14	19	17	18	13	19
C-14	14	15	15	18	15	16	13	20
C-15	18	19	16	20	17	18	13	21
C-16	16	19	13	19	16	20	13	21
C-17	21	22	15	22	19	23	14	22

Note : " – " Indicates no zone of inhibition

Table 5 Antifungal activity of chalcones (C-1 to C-17)

Compound	Zone of inhibition (in mm)			
	A.niger		*P.chrysogenium*	
	50 µg	100 µg	50 µg	100 µg
Standard	21	24	21	25
Control	-	-	-	-
C-1	08	07	06	08
C-2	09	11	10	13
C-3	10	09	11	11
C-4	13	14	11	13
C-5	11	12	08	07
C-6	11	14	11	12
C-7	02	04	05	08
C-8	03	02	06	07
C-9	20	21	19	21
C-10	12	13	13	18
C-11	18	20	19	22
C-12	11	12	12	17
C-13	11	13	11	14
C-14	11	12	13	12
C-15	18	21	19	20
C-16	13	15	11	15
C-17	12	13	12	17

Note: " – " Indicates no zone of inhibition

RESULTS, DISCUSSION AND SAR

Antibacterial activity

From the above results it is evident that all the chalcones synthesized, showed antibacterial activity at both 50 µg and 100 µg levels but the zones of inhibition not higher than the standard. Among the compounds tested, **C-17** was found to be more potent against *B.subtilis* and *E.coli* at both the dose levels tested. This compound was also active against *B.pumilis* and *P.vulgaris*, but only at a dose level of 100 µg. Compounds **C-13**, **C-15** and **C-16** also showed higher antimicrobial activity at the dose levels tested.

The structure-activity relationship study based on the above results clearly indicates that a 2-thienyl moiety in the place of aryl group (Ar) of the chalcone as seen in the case of **C-17** is essential for significant activity. This also suggests chalcones with substituents on both the thienyl rings can also be prepared with a hope to get compounds having much higher antimicrobial activity. The results also indicate, in general, a heteroaryl group in the place of simple or substituted aryl group contributes favorably to the inhibitory activity. Compounds with more number of electron releasing or electron with drawing substituents on the aromatic

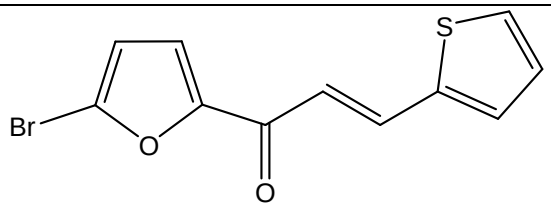
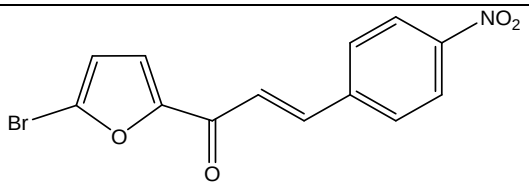
or heteroaromatic ring at different positions can be synthesized to draw meaningful conclusions with respect to the influence of electronic effects on the antimicrobial activity, as the present study could not establish clearly the influence of such groups.

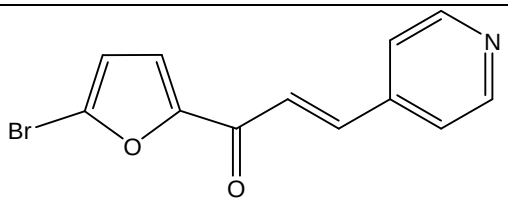
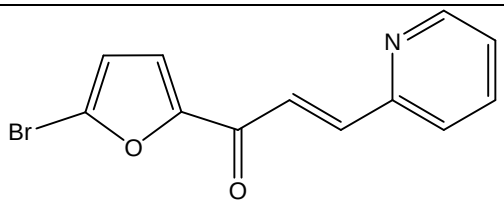
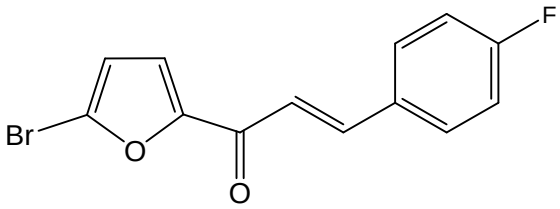
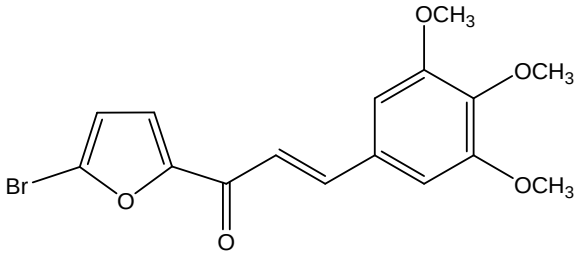
However, a close look at the substituents on the aryl moiety of the chalcones synthesized in the present study and their influence on antimicrobial activity, it is evident that a dimethylamino group present at the *para* position and a 3,4,5-trimethoxy substitution on the phenyl ring of **C-4** and **C-10** contributed to an increase in the antimicrobial activity.

Antifungal acitivity

Among the compounds tested for antifungal activity, compounds **C-9**, **C-11** and **C-15** were found to be more potent than the other compounds at both the dose levels tested, but less potent than the standard drug fluconazole. Structure-Activity-Relationship studies based on the above results indicate the necessity of fluorine at the *para* position of the phenyl ring. Since the fluorine substitution has contributed favorably to the inhibitory activity, a chalcone with two or more such substituents on the aromatic ring at different positions can be synthesized with a hope to get promising antibacterial compounds. Compound having the phenyl ring substituted with three methoxyls at 3, 4 and 5 positions has also enhanced the activity. Compounds having this type of substitution at other positions can be attempted as part of SAR studies and similarly chalcones with different substituents on pyridyl moiety can be synthesized, as 4-pyridyl moiety in the present study enhanced the activity. The results are consistent with the earlier literature.

MOST ACTIVE COMPOUNDS IDENTIFIED AS POTENTIAL ANTIMICROBIAL AGENTS

S.No	Chemical structure	Activity
1	 **C-17**	Antibacterial activity
2	 **C-13**	Antibacterial activity

3	 **C-15**	Antibacterial and antifungal activities
4	 **C-16**	Antibacterial activity
5	 **C-9**	Antifungal activity
6	 **C-11**	Antifungal activity

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Conflicts of interest

The authors have no conflicts of interest.

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