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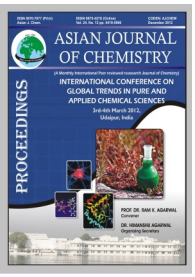

Microwave Assisted Synthesis and Antibacterial Activity of Chalcone Derivatives†

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Chalcone derivatives have been synthesized by equimolar reactions between substituted aldehydes and substituted acetophenones in basic medium by using conventional and microwave assisted technique. These compounds are characterized by FTIR and ^{1}H NMR spectra. Before characterization purity of these compounds has been checked by thin-layer chromatography method. These synthesized compounds have been screened for their antibacterial (*E. coli, S. aureus*) activities in different concentrations. The results showed that the chalcone derivatives are better at inhibiting growth of both types of bacteria (Gram negative and Gram positive) compared to chloramphenicol.

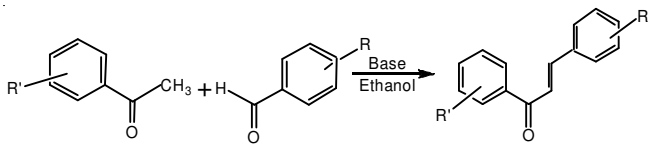
Key Words: Microwave, Chalcones, Bacteria, Antibacterial activity.

INTRODUCTION

In recent years, microwave assisted organic synthesis[1] has emerged as frontier devised to speed up the chemical reactions in pharmaceutical research for synthesis of newer drugs. Microwave assisted organic synthesis not only helped in implementing green chemistry but also led to the revolution in organic synthesis. Thus the use of microwave energy for the synthesis of organic compounds forms a part of green chemistry. Organic synthesis of chalcones play a vital role in green chemistry as their derivatives have received considerable attention in biological activities like antiinflammatory[2], antifungal[3], antibacteria1[4], antioxidant[5], antimalarial[6], antituberculosis[7], analgesic[8], anti HIV[9] and antitumor[10] activities. In present work chlorine, bromine containing chalcone derivatives have been successfully synthesized by using conventional and microwave technique. Completion of reaction was monitored by performing TLC and melting point. The structures of the synthesized compounds were confirmed by IR and ^{1}H NMR spectroscopy. These compounds were screened for their antibacterial activity against *S. aureus* (Gram +ve bacteria) and *E. coli* (Gram -ve bacteria).

EXPERIMENTAL

Chalcone was prepared by conventional and microwave assisted methods. The mixture of substituted acetophenone (0.01 mol) and substituted benzaldehyde (0.01 mol) in conical flask were dissolved in ethanol and aqueous solution of KOH (10 %) was added drop by drop with constant stirring. For conventional method the reaction mixture was stirred on magnetic stirrer and left for 24 h at room temperature whereas the heating was continued for 15 to 30 seconds at 480 W in microwave assisted method. A comparative study of reaction time and % yield of chalcones which were synthesized by classical and microwave irradiation methods is listed in Table-1. The reaction is generally carried in presence of aqueous alkali[11-17]. In comparison to the conventional method, yields obtained in microwave method were higher and cleaner.



Scheme-I: Reaction scheme of chalcones; {R': 4-Cl, 4-Br, R: H, 4-N$(CH_3)_2$, C_4H_4O}

Melting points were determined in open capillary tubes, expressed in ºC and are uncorrected. The time required for completion of the reaction was monitored by TLC and spots were exposed in iodine chamber. The IR spectra of the compounds were recorded on FTIR-8400 Shimadzu (Japan) spectrometer using KBr pellets and the values are expressed in cm^{-1}. The proton nuclear magnetic resonance (^{1}H NMR)

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spectra of the selected compounds were recorded on DZIRE400-vnmrs 400 spectrometer using acetone as solvent, TMS as an internal standard and chemical shift values are expressed in δ ppm. All the chemicals and solvents used were of laboratory grade.

Antibacterial activity of compounds was tested using paper disc method. Tested microorganism strains were *Escherichia coli* (ATCC 25922) and *Staphylococcus aureus* (ATCC 517324). Chloramphenicol was used as control drug.

TABLE-1
TIME TAKEN AND % YIELD FOR COMPOUNDS

Compound code	Conventional method		Microwave method	
	Time (h)	Yield (%)	Time (sec.)	Yield (%)
C1	8	77	15	95
C2	7	72	18	90
C3	7	45	15	80
C4	7	80	20	96
C5	8	64	25	94
C6	8	49	15	87

RESULTS AND DISCUSSION

1-(4'Chlorophenyl)-3-phenyl-2-propen-1-one (C1): m.p. 81-83 ºC; m.w. 242; creamy yellow powder, IR spectra (KBr, ν_{max}, cm^{-1}): 1652 (C=O), 1610 (CH=CH), 825 (C-Cl); ^{1}H NMR (acetone, δ ppm): 8.03-8.05 (1H, d, =CH-), 7.46-7.48 (1H, d, -CO-CH=), 7.65-7.77 (5H, m, Ar-H) 7.33-7.35 (4H, q, C_6H_4); Anal. calcd. (%) for $C_{15}H_{11}OCl$: C = 74.38; H = 4.55; Cl = 14.46.

1-(4'Chlorophenyl)-3-(4-dimethylaminophenyl)-2-propen-1-one (C2): m.p. 117-120 ºC; m.w. 285; bright yellow powder, IR spectra (KBr, ν_{max}, cm^{-1}): 1665 (C=O), 1590 (CH=CH), 812 (C-Cl); ^{1}H NMR (acetone, δ ppm): 7.98-8.0 (1H, d, =CH-Ar), 7.61-7.65 (1H, d, -CO-CH=), 7.42-7.47(4H, q, C_6H_4Cl), 7.54-7.56 (*o*-2H, d, phenyl ring), 6.64-6.66 (*m*-2H, d, phenyl ring), 2.93 (6H, s, $N(CH_3)_2$), Anal. calcd. (%) for $C_{17}H_{16}ONCl$: C = 71.58; H = 5.61; N = 4.91 %; Cl = 12.28.

1-(4'Chlorophenyl)-3-(furan-2-yl)-2-propen-1-one (C3): m.p. 85-87 ºC; m.w. 232; dark brown powder, IR spectra (KBr, ν_{max} ,cm^{-1}): 1654 (C=O), 1600 (CH=CH), 812 (C-Cl); ^{1}H NMR (acetone, δ ppm): 7.97-7.99 (1H, d, -CO-CH=), 7.66 (4H, s, C_6H_4), 7.37-7.50 (2H, m, furan ring) 6.88-6.89 (1H, d, =CH-furan ring), 6.52-6.53 (1H, q, furan); Anal. calcd. (%) for $C_{13}H_9O_2Cl$: C = 67.24; H = 3.88; Cl = 15.09.

1-(4'Bromophenyl)-3-phenyl-2-propen-1-one (C4): m.p. 81-82 ºC; m.w. 286; creamish yellow powder, IR spectra (KBr, cm^{-1}): 1651 (C=O), 1590 (CH=CH), 812 (C-Br); ^{1}H NMR (acetone, δ ppm): 7.95-7.97 (1H, d, =CH-), 7.62-7.64 (1H, d, =CO-CH), 7.62-7.81 (9H, m, Ar-H), Anal. calcd. (%) for $C_{15}H_{11}OBr$: C = 62.94; H = 3.85; Br = 27.62.

1-(4'Bromophenyl)-3-(4-dimethylaminophenyl)-2-propen-1-one (C5): m.p. 130-131 ºC; m.w. 329; orange powder, IR spectra (KBr, ν_{max}, cm^{-1}): 1650 (C=O), 1594 (CH=CH), 814 (C-Br); ^{1}H NMR (acetone, δ ppm): 7.91-7.93 (1H, d, =CH-Ar), 7.60-7.61 (1H, d, -CO-CH=), 7.44-7.47 (4H, d, C_6H_4Br), 7.54-7.56 (*o*-2H, d, phenyl ring) 6.64-6.66 (*m*-2H, d, phenyl ring) 2.92-2.93 (6H, d, $N(CH_3)_2$), Anal. calcd. (%) for $C_{17}H_{16}ONBr$: C = 62.01; H = 4.86; N = 4.26; Br = 24.01.

1-(4'Bromophenyl)-3-(furan-2-yl)-2-propen-1-one (C6): m.p. 60-62 ºC; m.w. 276; dark brown powder, IR spectra (KBr, ν_{max}, cm^{-1}): 1654 (C=O), 1596 (CH=CH), 820 (C-Br); ^{1}H NMR (acetone, δ ppm): 7.89-7.91 (1H, d, -CO-CH=), 7.61-7.66 (4H, t, C_6H_4), 7.36-7.50 (2H, q, furan ring), 6.88-6.89 (1H, d =CH-furan ring), 6.52-6.53 (1H, d, furan); Anal. calcd. (%) for $C_{13}H_9O_2Br$: C = 56.52; H = 3.26; Br = 28.62.

Antibacterial activity of synthesized compounds (C1-C6): All the synthesized compounds (C1-C6) were screened for their in vitro antibacterial activity at different concentrations against Gram-positive *S. aures* and Gram negative *E. coli* bacteria by the paper disc diffusion method. The zone of inhibition was measured in mm. Standard drug chloramphenicol was used as reference compound. The zone of inhibition was compared with the standard drug after 24 h of incubation at 37 ºC. All the compounds (C1-C6) exhibited moderate to good activity against the test organisms. The results are summarized in Tables 2 and 3 and Figs. 1 and 2.

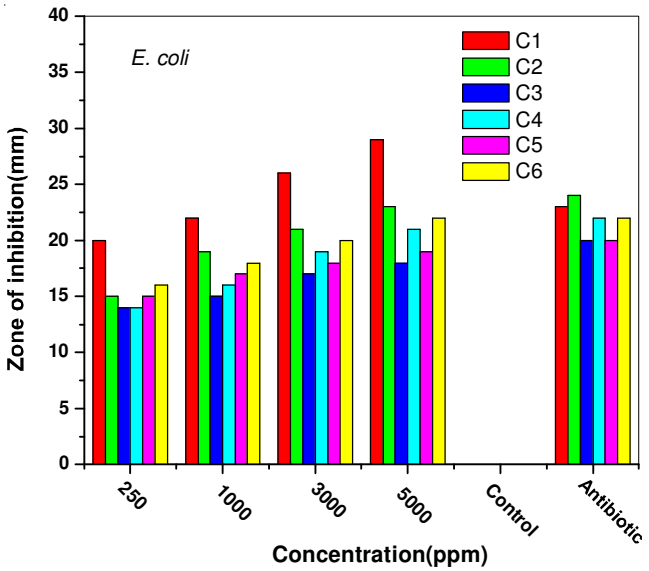

Fig. 1. Plot between inhibition growth of *E. coli* bacteria and concentration of solutions

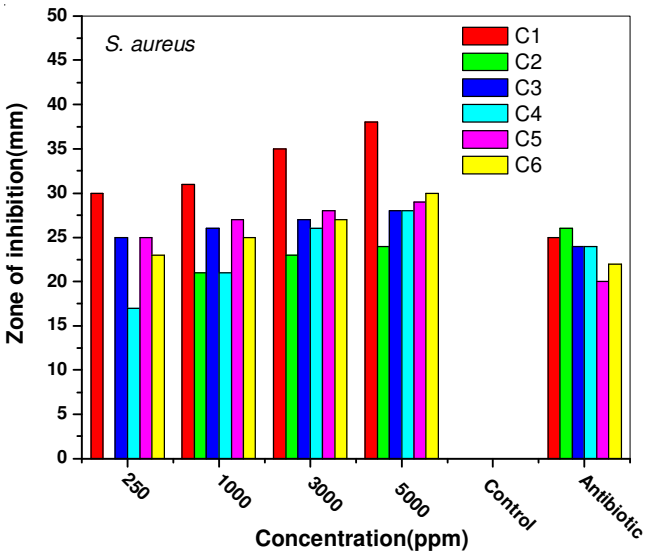

Fig. 2. Plot between inhibition growth of *S. aureus* bacteria and concentration of solutions

TABLE-2
ANTIBACTERIAL ACTIVITY OF SYNTHESIZED COMPOUNDS AGAINST *E. coli*

Concentration (ppm)	Zone of inhibition (mm) (gram negative)					
	C1	C2	C3	C4	C5	C6
250	20	15	14	14	15	16
1000	22	19	15	16	17	18
3000	26	21	17	19	18	20
5000	29	23	18	21	19	22
Control	-	-	-	-	-	-
Antibiotic	23	24	22	22	20	22

(-) no inhibition zone

TABLE-3
ANTIBACTERIAL ACTIVITY OF SYNTHESIZED COMPOUNDS AGAINST *S. aureus*

Concentration (ppm)	Zone of inhibition (mm) (gram positive)					
	C1	C2	C3	C4	C5	C6
250	30	-	25	17	25	23
1000	31	21	26	21	27	25
3000	35	23	27	26	28	27
5000	38	24	28	28	29	30
Control	-	-	-	-	-	-
Antibiotic	25	26	24	24	24	23

(-) No inhibition zone

Conclusion

Microwave irradiated synthesis of chalcones was carried out to get higher yield with less reaction time period as compared to conventional method. The synthesized chalcones produce yield around 50-65 % (conventional) and 90-100 % (microwave). The chalcones were tested for their antibacterial activity. The result shows that chalcones containing chloro/bromo substituents were active while other possessed moderate activity against bacteria.

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