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Synthesis and Antimicrobial Activity of Some Chalcone Derivatives

Balkrishna Tiwari*[1], AS Pratapwar[2], AR Tapas[2], SR Butle[1]and BS Vatkar[1]

[1]School of Pharmacy, S.R.T.M. University,Nanded - 431606, (M.S.), India.

[2]S.N. Institute of pharmacy, Pusad- 445204 (M.S.),India.

*Corresponding author:tiwaribd@ymail.com
Tel.No. 919021963033.*

ABSTRACT: In an effort to develop antimicrobial agents, a series of chalcones were prepared by Claisen-Schmidt condensation of appropriate acetophenones with appropriate aromatic aldehydes in the presence of aqueous solution of potassium hydroxide and ethanol at room temperature. The synthesized compounds were characterized by means of their IR, ^{1}H-NMR spectral data. All the compounds were tested for their antibacterial and antifungal activities by the cup plate method.

KEY WORDS: Chalcone, Synthesis, Antibacterial activity, Antifungal activity

INTRODUCTION

Survival of the fittest is the basis for life and for the human beings also. The biggest threats for human beings are the various diseases and scientists and doctors are still fighting to find solutions with various forms of medications. Today's developed medicines are results of relentless effort made by human civilization time to time. When the era of synthetic drugs began, it opened thousand doors for the development of various synthetic molecules with potential action.

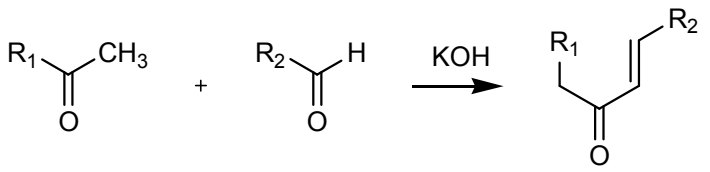
Chalcones are well known intermediates for synthesizing various heterocyclic compounds. The compounds with the backbone of chalcones have been reported to possess various biological activities such as antimicrobial[1,2,3], anti-inflammatory[4], antimalarial[5,6], antileishmanial[7], antioxidant[8], antitubercular[9,10], The presence of a reactive α,β-unsatutated keto function in chalcones was found to be responsible for their antimicrobial activity. In the present work we report the reaction of various substituted acetophenone with different substituted aromatic aldehyde to form chalcones (IIIa-k). The structures of the various synthesized compounds were assigned on the basis of IR, ^{1}H-NMR spectral data. These compounds were screened for their antimicrobial activity.

EXPERIMENTAL

Melting points were recorded on SUPERFIT melting point apparatus in open capillary tubes and are uncorrected. The IR spectra were recorded in KBr on SHIMADZU FT-IR – 8400 spectrophotometer. The 1H-NMR were recorded in $CDCl_3$ on a Varian mercury YH-300 NMR Spectrometer using TMS as an internal standard. The purity of the compounds was checked by TLC-using Silica gel-G (Merck). Column chromatography was performed on Silica gel (Merck, 60-120 mesh).

General procedure for the preparation of 1-(substitutedphenyl)-3-(substitutedphenyl)-2-propen-1-ones (IIIa-k)

A mixture of substituted acetophenones (0.01 mole) and aryl aldehydes (0.01 mole) was stirred in 90% ethanol (30 mL) and then an aqueous solution of potassium hydroxide (15 mL) was added to it. The mixture was kept over night at room temperature and then it was poured into crushed ice and acidified with dilute hydrochloric acid. The chalcone derivative precipitates out as solid. Then it was filtered and crystallized from ethanol.



IIIa) R_1 = 4-F C_6H_4, R_2 = 3-OH C_6H_4

IIIb) R_1 = 4-F C_6H_4, R_2 = 3-NO_2 C_6H_4

IIIc) R_1 = 4-F C_6H_4, R_2 = 3-Cl C_6H_4

IIId) R_1 = 4-F C_6H_4, R_2 = 4-F C_6H_4

IIIe) R_1 = 4-F C_6H_4, R_2 = 4-CH_3 C_6H_4

IIIf) R_1 = 4-F C_6H_4, R_2 = 3, 4-OCH_3 C_6H_4

IIIg) R_1 = 4-NO_2 C_6H_4, R_2= 3- NO_2 C_6H_4

IIIh) R_1 = 4-NO_2 C_6H_4, R_2= 3- Cl C_6H_4

IIIi) R_1 = 4-NO_2 C_6H_4, R_2= 4- F C_6H_4

IIIj) R_1 = 4-NO_2 C_6H_4, R_2= 4- CH_3 C_6H_4

IIIk) R_1 = 4-NO_2 C_6H_4, R_2= 3,4- OCH_3 C_6H_4

Table No. 1 Observation Table

Sr.No.	Com.	Mol. formula	Mol. Wt.	Yield %	M.P. °C	Rf value
1	**IIIa**	$C_{15}H_{11}FO_2$	242	60.2	74-76	0.75
2	**IIIb**	$C_{15}H_{10}FNO_3$	271	79.6	206-208	0.65
3	**IIIc**	$C_{15}H_{10}ClFO$	260	75.6	78-80	0.86
4	**IIId**	$C_{15}H_{10}F_2O$	244	66.9	114-116	0.82
5	**IIIe**	$C_{16}H_{13}FO$	240	69.7	136-138	0.78
6	**IIIf**	$C_{17}H_{15}FO_3$	286	63.8	76-78	0.76
7	**IIIg**	$C_{15}H_{10}N_2O_5$	298	57.5	206-208	0.83
8	**IIIh**	$C_{15}H_{10}ClNO_3$	287	57.9	164-168	0.65
9	**IIIi**	$C_{15}H_{10}FNO_3$	271	51.0	122-124	0.69
10	**IIIj**	$C_{16}H_{13}NO_3$	267	47.3	154-156	0.81
11	**IIIk**	$C_{17}H_{15}NO_5$	313	50.8	96-98	0.62

Table 2. Spectral data of the selected compounds

Compound code	IR (Cm^{-1}, KBr)	^{1}H NMR (CDCl3/ δ (ppm)
IIIa	3363 (OH), 3070 (CH-Ar), 1677 (C=O), 1600 (CH=CH), 837 (C-F)	7.68 (1H, d, CH-Ar), 7.38 (1H, d, -CO-CH=), 6.4-8.1 (8H, m, Ar-H) 6.0 (1H, s, C-OH).
IIIb	3074 (CH-Ar), 1677 (C=O), 1600 (CH=CH), 840 (C-F).	-------
IIIc	3074 (CH-Ar), 1666 (C=O), 1604 (CH=CH), 840 (C-F), 813 (C-Cl)	7.8 (1H, d, CH-Ar), 7.36 (1H, d, -CO-CH=), 6.8-8.1 (8H, m, Ar-H).
IIId	3074 (CH-Ar), 1658 (C=O), 1600 (CH=CH), 821 (C-F)	7.8 (1H, d, CH-Ar), 7.6 (1H, d, -CO-CH=), 6.8-8.2 (8H, m, Ar-H).

IIIe	3074 (CH-Ar), 1658 (C=O), 1600 (CH=CH), 1334 (C-CH_3), 821 (C-F)	7.8 (1H, d, CH-Ar), 7.54 (1H, d, -CO-CH=), 7.1-8.1 (8H, m, Ar-H), 2.4 (3H, s, CH_3).
IIIf	3070 (CH-Ar), 1662 (C=O), 1596 (CH=CH), 1141 (C-O-CH_3), 837 (C-F)	7.36 (1H, d, CH-Ar), 6.92 (1H, d, -CO-CH=), 6.4-8.2 (7H, m, Ar-H), 3.85 (6H, s, OCH_3).
IIIg	3475,1350 (CH-NO_2), 3085 (CH-Ar), 1693 (C=O), 1593 (CH=CH)	7.5 (1H, d, CH-Ar), 6.7 (1H, d, -CO-CH=), 7.2-8.0 (8H, m, Ar-H).
IIIh	3480,1330 (CH-NO_2), 2975 (CH-Ar), 1691 (C=O), 1591 (CH=CH), 815 (C-Cl)	7.5 (1H, d, CH-Ar), 7.25 (1H, d, -CO-CH=), 6.7-8.0 (8H, m, Ar-H).
IIIi	3363,1338 (CH-NO_2), 2981 (CH-Ar), 1658 (C=O), 1593 (CH=CH), 825 (C-F)	7.9 (1H, d, CH-Ar), 7.68 (1H, d, -CO-CH=), 6.7-8.5 (8H, m, Ar-H).
IIIj	3458,1311 (CH-NO_2), 2974 (CH-Ar), 1704 (C=O), 1587 (CH=CH), 1344 (C-CH_3)	7.85 (1H, d, CH-Ar), 7.58 (1H, d, -CO-CH=), 6.7-8.4 (8H, m, Ar-H), 2.38 (3H, s, CH_3).
IIIk	3490,1309 (CH-NO_2), 2935 (CH-Ar), 1722 (C=O), 1522 (CH=CH), 1168 (C-O-CH_3)	7.8 (1H, d, CH-Ar), 6.7 (1H, d, -CO-CH=), 6.8-8.2 (7H, m, Ar-H), 4.0 (6H, s, OCH_3).

Table No. 3 Antimicrobial Activity of derivatives

Compounds	Antibacterial*		Antifungal*	
	E. c.	***P. a.***	***A. n.***	***A. f.***
III a	15	14	10	12
III b	08	08	12	10
III c	12	09	06	08
III d	09	10	12	08
III e	08	12	11	12
III f	08	10	09	12
III g	10	10	08	09
III h	12	09	12	08
III i	10	10	12	13
III j	09	08	13	12
III k	14	08	11	10
Streptomycin	18	18	--	--
Fluconazole	--	--	14	13

*Zone of inhibition was measured in mm. *Escherichia coli (E.c.), Pseudomonas aeruginosa (P.a), Aspergillus niger (A.n.), Aspergillus flavus (A.f.).*

ANTIMICROBIAL ACTIVITY:

The synthesised compounds (IIIa-IIIh) were screened for their in vitro antimicrobial activity against *Escherichia coli, Pseudomonas aeruginosa* and antifungal activity against *Aspergillus niger, Aspergillus flavus,* by measuring the zone of inhibition in mm. The antimicrobial activity was performed by filter paper disc plate method[12,13] at concentration 100 µg/mL and reported in Table-3. Muller Hinton agar & Sabouroud Dextrose agar were employed as culture medium and DMSO was used as solvent control for antimicrobial activity. Streptomycin and Fluconazole were used as standard for antibacterial and antifungal activities respectively.

CONCLUSION

Structures of the synthesized substituted chalcones were confirmed from their respective IR,^{1}H- NMR studies. From the antimicrobial screening it was observed that all the compounds exhibited activity against all the organisms employed. The compounds IIIa,IIIc,IIIg,IIIh and IIIk shows good antibacterial activity where as other compounds showed moderate to good activity. Fungicidal screening data also revealed that compounds IIIa,IIIb,IIIc,IIIe,IIIj,and IIIk imparted maximum activity , where as other compounds showed moderate to good activity. As we consider all results obtained from antibacterial and antifungal tests together we can say that entire compounds tested are active towards bacteria and fungi.

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