International Journal of Universal Science and Technology
ISSN: **ISSN: 2454-7263** Copyright © Universal Print
Volume No. 03, Issue No. 04, Page No. 199-205 Published: Jan. 2018
Web: www.universalprint.org , Email: ijup@universalprint.org
Title Key: Synthesis, Spectral Studies and Biological …

Synthesis, Spectral Studies and Biological Screening of Novel Series of Chalcones

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Abstract

A novel series of chalcones (3a-k) have been synthesized by Claisen-Schmidt condensation between aromatic ketone and several aromatic aldehydes in the presence of potassium hydroxide. The structures of the compounds were confirmed by FTIR, ^{1}HNMR, MASS spectral data. All the novel chalcones were screened for their antimicrobial activities(agar disc-diffusion method).

Keywords: Chalcone, Spectral Studies, Biological activity.

1. Introduction

True importance of chalcone is extended into two branches, One is biological activity associated with them which includes antimalarial (Motta ,2006; Awasthi *et al*, *Med Chem Res,* 2009 and Lim SS, 2007), anticancer (Achanta G .2006; Echeverria C, 2009 and Ilango K, 2010), anti-inflammatory (Yadav HL,2010 and Zhang XW,2010), antimicrobial (Hamdi N,2010 ; Bhatia NM,2009; Awasthi SK , *Amer J Top Med Hyg* , 2009; Bag S,2009 and Lahtchev KL,2008) anticonvulsant (Kaushik S.2010), antioxidant (Vasil'ev RF, 2009; Sivakumar PM ,2010 and Vogel S,2008), xanthine oxidase inhibitor, aldol reductase inhibitor, epoxide hydrolase inhibitor (Najafian M, 2010; Zarghi A ,2006 and Chimenti F ,2009), and other one is its use as a template for synthesis of various heterocyclic compounds such as pyrimidine, pyrazoline, benzofurans, thiadiazines, isoxazole, quinolinones, benzodiazepine, etc. Some of these synthesized compounds show significant therapeutic activity (Gaede BJ,1993; Shibatai K,1993; EI- Hamouly Ws ,2011and Abonic R,2008). There are different methods reported for the synthesis of chalcone analogues, most commonly used one is Claisen-Schmidt condensation reaction. They can be synthesized conventionally by acid or base catalyzed method. However, Green chemistry approaches are more beneficiary to synthesize chalcone derivatives so as to avoid pollution, use of toxic reagents and strongly acidic or basic condition (Jayapal MR,2010). The different traditional methods used for synthesizing these chalcones such as base catalyzed (NaOH, KOH, $Ba(OH)_2$) and acid catalyzed (including Lewis acids) condensation processes in the presence of suitable solvent, many new eco-friendly methods like use of ultrasonic radiations (Chtourou, M,2009), microwave assisted (Abdel-Aziz, H. A, 2011), solvent free synthesis by grinding (Rateb, N. M, 2005).

2. Materials And Methods

Experimental

Melting points were uncorrected and determined in open capillaries. The purity of the compound is checked by TLC. The IR spectra were recorded on Shimadzu FT-IR Spectrometer using potassium bromide pellets,

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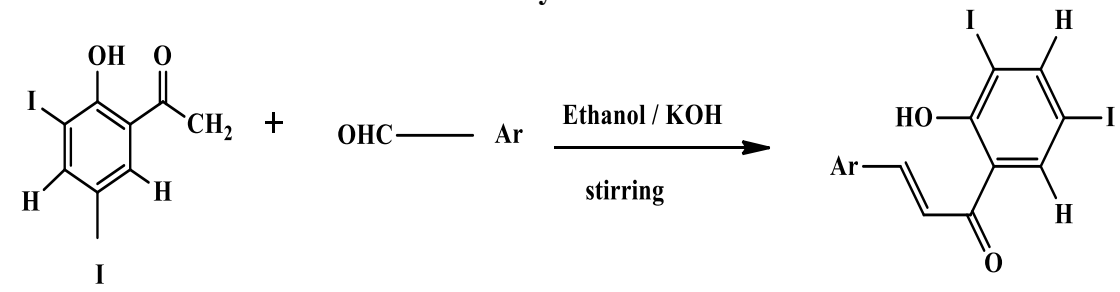
and ^{1}HNMR spectra were recorded on a Bruker Avance II 400 Spectrometer against TMS as internal standard. Mass spectra were recorded on Waters Micromass Q-Tof Micro spectrometry.

General Procedure for the Synthesis Chalcones

A mixture of substituted benzaldehyde (1 mmol) with 2- hydroxy, 3,5-diiodo acetophenone(1 mmol) in ethanol (40 ml) was added (2 mmol) solution of potassium hydroxide. The reaction mixture was then stirred for 1 hr in ice bath, after completion of the reaction (monitored by TLC) the reaction mixture was poured into an ice cold solution of water. The solid obtained washed with water and crystallized from ethanol.

Scheme-1 Synthesis Chalcones



1 2 Chalcone (3a-k)

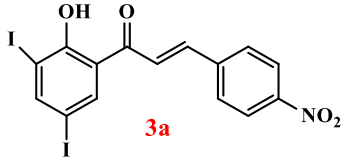
3. Result and Discussion

We have reported the newly chalcones which were carried out according to the Claisen-Schmidt condensation of an ortho hydroxy ketone with several aromatic aldehyde as indicated to Scheme1.

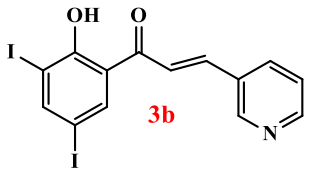
The synthesized chalcones confirmed by IR spectral data showing sharp bands in the range between 1600 – 1660 cm^{-1} indicated the presence of the C=O group. Chalcones (3a-k) were also confirmed by ^{1}HNMR spectral analysis. Inspection of the ^{1}HNMR spectra suggested that the chalcones were geometrically pure and configured trans ($JH_\alpha=H_\beta=15Hz$).

The antimicrobial activity of the newly chal cones was evaluated by
Disc diffusion Method (H. Afaf, 2000)

Structures of Synthesized Chalcones



(*E*)-1-(2-hydroxy-3,5-diiodophenyl)-3-(4-nitrophenyl)prop-2-en-1-one



(*E*)-1-(2-hydroxy-3,5-diiodophenyl)-3-(pyridin-3-yl)prop-2-en-1-one

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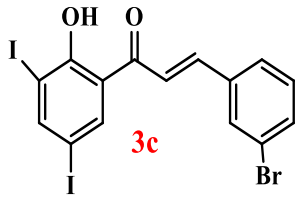
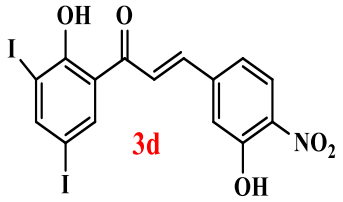


(*E*)-3-(3-bromophenyl)-1-(2-hydroxy-3,5-diiodophenyl)prop-2-en-1-one



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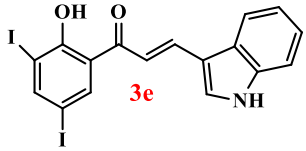

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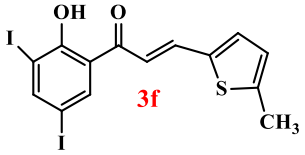

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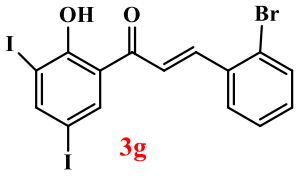
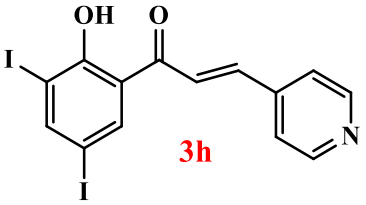
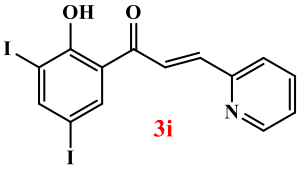


(*E*)-3-(2-bromophenyl)-1-(2-hydroxy-3,5-diiodophenyl) prop-2-en-1-one



(*E*)-1-(2-hydroxy-3,5-diiodophenyl)-3-(pyridin-4-yl) prop-2-en-1-one



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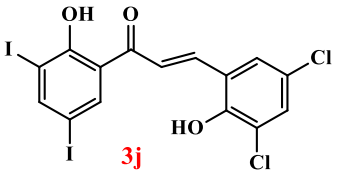
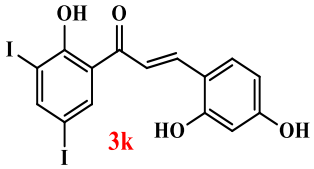


(*E*)-3-(3,5-dichloro-2-hydroxyphenyl)-1-(2-hydroxy-3,5-diiodophenyl)prop-2-en-1-one



(*E*)-3-(2,4-dihydroxyphenyl)-1-(2-hydroxy-3,5-diiodophenyl)prop-2-en-1-one

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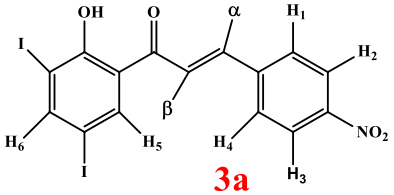
Table-1 The Physical data of Synthesized Chalcones(3a-k)

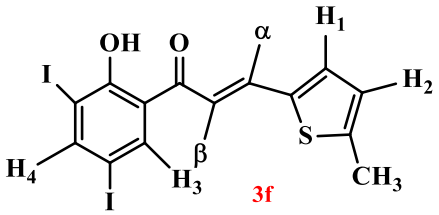
Entry	Product	Mol. Formula	Yield %	M.P.(°C)
1	3a	$C_{15}H_9O_4NI_2$	90	194
2	3b	$C_{14}H_9O_2NI_2$	85	192
3	3c	$C_{15}H_9O_2I_2Br$	80	162
4	3d	$C_{15}H_9O_5NI_2$	90	110
5	3e	$C_{17}H_{11}O_2NI_2$	92	150
6	3f	$C_{14}H_{10}O_2I_2S$	94	108
7	3g	$C_{15}H_9O_2I_2Br$	80	130
8	3h	$C_{14}H_9O_2NI_2$	80	174
9	3i	$C_{14}H_9O_2NI_2$	75	100
10	3j	$C_{15}H_8O_3I_2Cl_2$	75	166
11	3k	$C_{15}H_{10}O_4I_2$	90	170

Spectral analysis of selected chalcones:



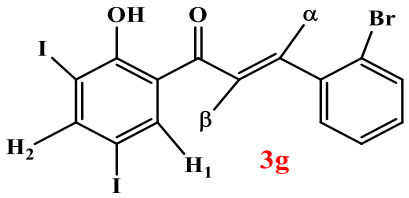
3a

FTIR (KBr, cm^{-1}):- 1640 (C=O) ,1589(C=C) , 1427 (C-C Aromatic str) .
^{1}HNMR :- 7.19(d ,1H_1), 7.62(d ,1H_2), 7.66(d ,1H_3), 7.78(d ,1H_4), 7.81(d ,1H ,Hα, J=15Hz), 8.17(d, 1H, Hβ,J=15Hz),8.17(s ,1H, H_5), 8.22(s ,1H, H_6), 13 (s,1H,OH) .
M.S. (M/z):- 521(M+1) .



3f

FTIR (KBr, cm^{-1}):- 1630 (C=O) ,1557(C=C) , 1433(C-C Aromatic str).
^{1}HNMR :- 2.52(s, 3H, CH_3), 6,69(d ,1H_1), 6.91(d ,1H_2), 7.55(d ,1H ,Hα, J=15Hz), 7.98(d, 1H, Hβ,J=15Hz), 8.18(d ,1H_3), 8.23(d ,1H_4), 8.17(s ,1H, H_5), 8.22(s ,1H, H_6), 13.90 (s,1H,OH) .
M.S. (M/z):- 521(M+1) .



3g

FTIR (KBr, cm^{-1}):- 1640 (C=O) ,1588(C=C) , 1429(C-C Aromatic str), 665(C-Br).
^{1}HNMR :- 7.67 (d ,1H ,Hα, J=15Hz), 7.35-8.02(m ,5H, H-Aromatic), 8.20(d ,1H, H_5), 8.24(d, 1H, Hβ,J=15Hz), 8.53(s ,1H, H_6), 13.88 (s,1H, OH).
M.S. (M/z):- 554(M+1) .

Antimicrobial activity

Antimicrobial screening was used disc diffusion method(H. Afaf,2000) at a concentration of 100µg/ml, adopted with some modification for the prepared compound using Penciline and Streptomycin as references. The prepared compounds were tested against one strain of Gram +ve bacteria, Gram –ve bacteria, fungi. The compounds were evaluated for antibacterial activity against *Staphylococcus aureus gr +ve, Escherichia coli gr –ve Bacillus subtilis gr +ve, Salmonella typhi gr –ve* and antifungal activity against *Aspergillus oryzoe, Aspergillus niger,*. DMSO

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was used as solvent control. The results of antimicrobial data are summarized in **Table 2**. The compounds show the moderate to good activity against bacteria and fungi.

Table-2. Antimicrobial activity of Chalcones (3a-k).

Compounds	Gram positive bacterias		Gram negative bacterias		Fungus	
	Staph aureus	***Bacillus subtilis***	***Escherichia coli***	***S. typhi***	***Aspergillus oryzoe***	***Aspergillus niger,***
3a	-	-	-	-	-	-
3b	+	+	-	-	-	-
3c	-	-	-	-	-	-
3d	+	+	-	-	+	+
3e	+	+	-	+	+	+
3f	-	-	-	-	-	-
3g	-	+	-	-	+	+
3h	-	+	-	-	+	+
3i	+	+	-	-	+	+
3j	-	-	-	-	+	+
3k	+	+	-	-	-	-
DMSO	-	-	-	-	+	-
Penicilline 1	+	+	+	+	x	x
Streptomycin 2	++	++	++	++	x	x
Greseofulvin	x	x	x	x	-	-

(++) = Clear Zone of Inhibition , (+) = Minimum Zone of Inhibition, (-) = No Effect, X = Not applicable, Standerd [1] Penciline (+), Standard [2] ,Streptomycin (++) ,Greseofulvin (fungus)

4. Conclusion

In this work, we have synthesized Chalcones (3a-k) by the reaction of 2-hydroxy acetophenone with substituted aldehydes with good yield, this method has the advantage of mild and efficient chemistry techniques, reaction time is short, the workout is easy. The newly synthesized Chalcones (3a-k) were confirmed by spectral analysis and further evaluated for their antimicrobial activity.

5. Acknowledgement

The authors are thankful to The Head Department of Chemistry, Head, The Department of Microbilogy, The Principal, Yeshwant College, Nanded for providing lab facilities for the research work.

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