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Research Article

Green Synthesis And Biological Evaluation Of A, B - Unsaturated Carbonyl Compounds By Microwave Irradiation And Conventional Methods

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ABSTRACT

α, β-unsaturated carbonyl compounds are organic molecules that share enones and enals' general structure. They are adaptable molecules with a diverse array of biological functions. One significant class of naturally occurring bioactive substances are flavonoids. Chalcones are a significant class of flavonoids that can be made using the claisen process. Their biological functions and industrial applications are diverse. They are produced synthetically by claisen schmidt condensation, which permits the cross-aldol condensation of suitable aldehydes and ketones by an acid- or alkaline-catalyzed reaction that subsequently permits dehydration. As a result, it is thought to be worthwhile to conduct a comparative study using conventional and microwave assisted synthesis (by applying green chemis try) to carry out biological activity like (antimicrobial and antifungal activity). The research study has been conducted as result the microwave assisted synthesis was found to be superior over convectional method and after performing anti-microbial and anti-fungal activities few of the group have showed good activities as a result further studies is required.

INTRODUCTION

Diaryl propinones are widely distributed in nature and originate from the ferns of higher plants. These are compounds with an unsaturated side chain that are aromatic. It has been determined that the diaryl propinones have anti-bacterial, anti-

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fungal, and insecticidal characteristics since they have been documented to have analgesic, anti-inflammatory, and anti-pyretic qualities. Likewise, possess qualities that are anti-hypertensive, anti-diabetic, and antioxidant. the diaryl propinones, which have three carbon α, β-unsaturated carbonyl systems connecting two or more aromatic rings. They are discovered to be naturally occurring in edible plants and serve as building blocks for the synthesis of flavonoids and isoflavonoids. The term "chalcone" was initially used by Kostanecki, who also accomplished grounder aking work in the synthesis of naturally occurring coloring agents. Chalcones are 1,3-diphenyl-2-propene-1-one compounds with three carbons and an unsaturated carbonyl system (α, β) connecting the aromatic rings. They are thought to be the precursors of flavonoids and isoflavonoids and are found in large quantities in edible plants (Rajendrapr asad et al, 2008), (Chetana B et al, 2009).1,2

Diaryl propinones and their derivatives have been found to be processes of variety of biological and pharmacological activities like Cytotoxic, Anticancer Chemo protective, anti-proliferative, anti-malarial, anti-viral, anti-HIV activities, etc. Chemistry has become more and more popular as a replacement for the standard, conventional method of synthesis because it is renowned for its quick organic synthesis, ease of access to high temperatures, good control over the amount of energy added to the reaction, and higher yields. Some of the newly synthesized derivatives were tested as antiviral agents against HAV. In addition, the cytotoxic activity of Some prepared deriva tives against HepG2 and MCF-7 Cell lines was evaluated (Arshi et al ,2009) ,(Vyas et al,2009) .3,4

Experimental part

General procedure for the synthesis of chalcones by Claisen-Schmidt condensation

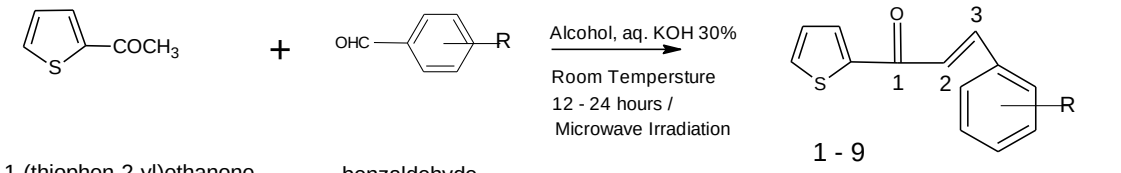
A. Conventional Method of Synthesis

Equimolar quantities (0.001mol) of 2-acetylthiophene and respective aldehydes (0.001mol), were mixed and dissolved in minimum amount (3ml) of alcohol, to this aqueous potassium hydroxide solution (30%) was added slowly and mixed occasionally for 24 hrs, at room temperature. Completion of the reaction was identified by observing on precoated TLC plates of Merck. After completion of the reaction, the reaction mixture was poured into crushed ice, if necessary acidified with dil HCl. The solid separated was filtered and dried. It was purified by recrystallization or by column chromatography performed on silica gel (100-200 Mesh, Merck), using ethyl acetate and hexane mixture as mobile phase.5

B. Microwave Assisted Synthesis

Equimolar quantities (0.001mol) of 2-acetylthiophene and respective aldehydes (0.001mol) were mixed and dissolved in minimum amount (3ml) of alcohol; to this aqueous potassium hydroxide solution (30%) was added slowly and mixed. The entire reaction mixture was microwave irradiated for about 2-6 minutes at 180 watts, then kept aside for 1-3 hrs. Completion of the reaction was identified by observing on precoated TLC plates of Merck. After completion of the reaction, the reaction mixture was poured into crushed ice, if necessary acidified with dil HCl. The solid separated was filtered and dried. It was purified by recrystallization or by column chromatography performed on silica gel (100-200 mesh, Merck), using ethylacetate and hexane mixture as mobile phase. 6

SCHEME



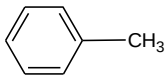
1-(thiophen-2-yl)ethanone benzaldehyde

1 - 9

3-phenyl-1-(thiophen-2-yl)prop-2-en-1-one

R

1.



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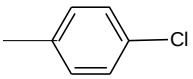

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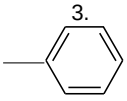

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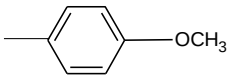

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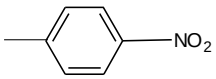

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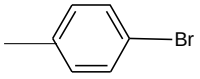

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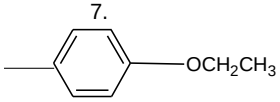

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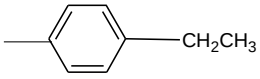

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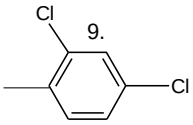


Table 1. Microwave Method

Sr. No	IUPAC name	Mol. For	Mol.wt	M.P	Micro-wave time	% yield
1	3-(4 methylphenyl)- 1-(thiophen-2-yl) prop-2-en-1-one	$C_{14}H_{12}OS$	228 ± 2	110 ± 5°c	5min	88%

2	3-(4-chlorophenyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_9OSCl$	248	110 ± 5℃	5 min	85%
3	3-phenyl-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_{10}OS$	214	90 ± 5°c	5 min	90%
4	3-(4-methoxyphe nyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{14}H_{12}O_2S$	244	110 ± 5°c	5 min	80%
5	3-(4-nitrophenyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_9O_3NS$	259	110 ± 5°c	5 min	78%
6	3-(4-bromophenyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_9BrOS$	293	110 ± 5°c	5 min	88%
7	3-(4-ethoxyphenyl) -1-(thiophen-2-yl) prop-2-en-1-one	$C_{15}H_{14}O_2S$	258	110 ± 5°c	5 min	87%
8	3-(4-ethylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{15}H_{14}OS$	242	110 ± 5°c	5 min	82%
9	3-(2,4-dichloroph enyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_8OSCl_2$	283	110 ± 5°c	5 min	85%

Table 2. Convectional Method

Sr. No	IUPAC name	Mol. for	Mol.wt	M.P	Conventional time	% yield
1	3-(4 methylphenyl)- 1-(thiophen-2-yl) prop-2-en-1-one	$C_{14}H_{12}OS$	228 ± 2	110 ± 5°c	24hrs	78%
2	3-(4-chlorophenyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_9OSCl$	248	110 ± 5℃	24hrs	82%
3	3-phenyl-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_{10}OS$	214	90 ± 5°c	24hrs	87%
4	3-(4-methoxyphe nyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{14}H_{12}O_2S$	244	110 ± 5°c	24hrs	70%
5	3-(4-nitrophenyl)-1-(thiophen-2-yl) prop-2-en-1-on	$C_{13}H_9O_3NS$	259	110 ± 5°c	24hrs	60%
6	3-(4-bromophenyl)-1-(thiophen-2-yl) prop-2-en-1-one.	$C_{13}H_9BrOS$	293	110 ± 5°c	24hrs	80%

7	3-(4-ethoxyphenyl) -1-(thiophen-2-yl) prop-2-en-1-one	$C_{15}H_{14}O_2S$	258	110 ± 5°c	24hrs	76%
8	3-(4-ethylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{15}H_{14}OS$	242	110 ± 5°c	24hrs	74%
9	3-(2,4-dichloroph enyl)-1-(thiophen-2-yl) prop-2-en-1-one	$C_{13}H_8OSCl_2$	283	110 ± 5°c	24hrs	81%

Spectral data

1)**Mass spectrum:** 3-(4-methylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one

Molecular weight **229.0689** was found.

1H NMR: When 2- acetylthiophene reacted with 4-Methylbenzaldehyde, It show following spectral data of NMR

(1H, d, J=16Hz , –CO–CH=), 7.56 (1H, d, J=16Hz, =CH–Ar), 7.88 (1H, d, J=9Hz, –C–51–H), 7.68 (2H, d, –C–2–H, –C–6–H), 7.58 (1H, d, J=8Hz, –C–31–H), 7.23 (2H, d, –C–3–H, –C–5–H), 7.19 (1H, m, –C–41–H).

1. **IR (cm^{-1}):** .1732 (C=O), 1645 (HC=CH), 652(C-S)

2. **Name:** 3-(4-chlorophenyl)-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1725 (C=O), 1640 (HC=CH) 650 (C-S). 850 (C-Cl)

3. **Name:** 3-phenyl-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1700 (C=O), 1650 (HC=CH), 650 (C-S)

4. **Name:** 3-(4-methoxyphenyl)-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1720 (C=O), 1648 (HC=CH), 1170 (-OCH3). 666 (C-S)

5. **Name:** 3-(4-nitrophenyl)-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1720 (C=O), 1640 (HC=CH), 650 (C-S). 450(NO_2)

6. **Name:** 3-(4-bromophenyl)-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1720 (C=O), 1640 (HC=CH), 650 (C-S). 850 (C-Br)

7. **Name:** 3-(4-ethoxyphenyl)-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1720 (C=O), 1640 (HC=CH), 650 (C-S).

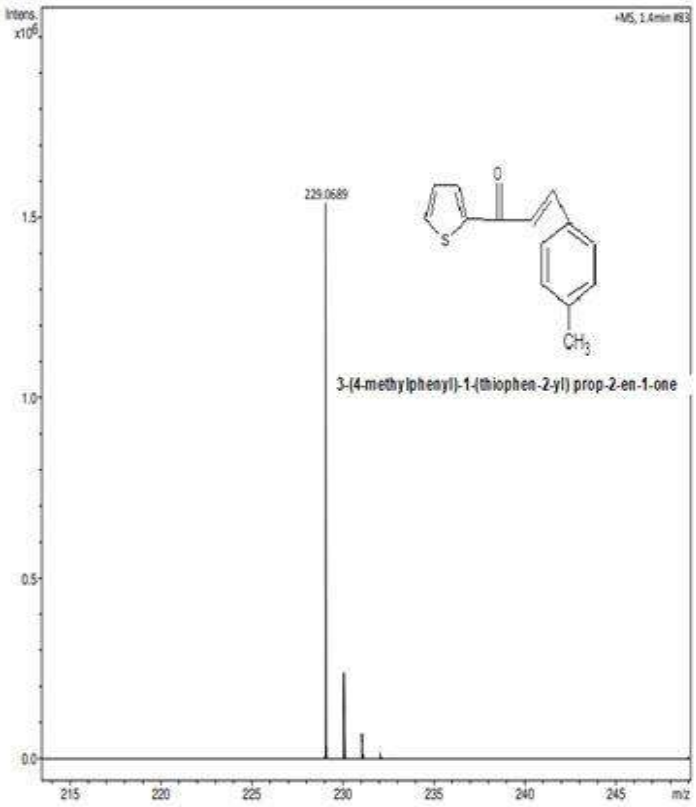
8. **Name:** 3-(4-ethylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one
   IR (cm^{-1}): 1720 (C=O), 1640 (HC=CH),650 (C-S).

9. **Name:** 3-(2,4-dichlorophenyl)-1-(thiophen-2-yl) prop-2-en-1-one

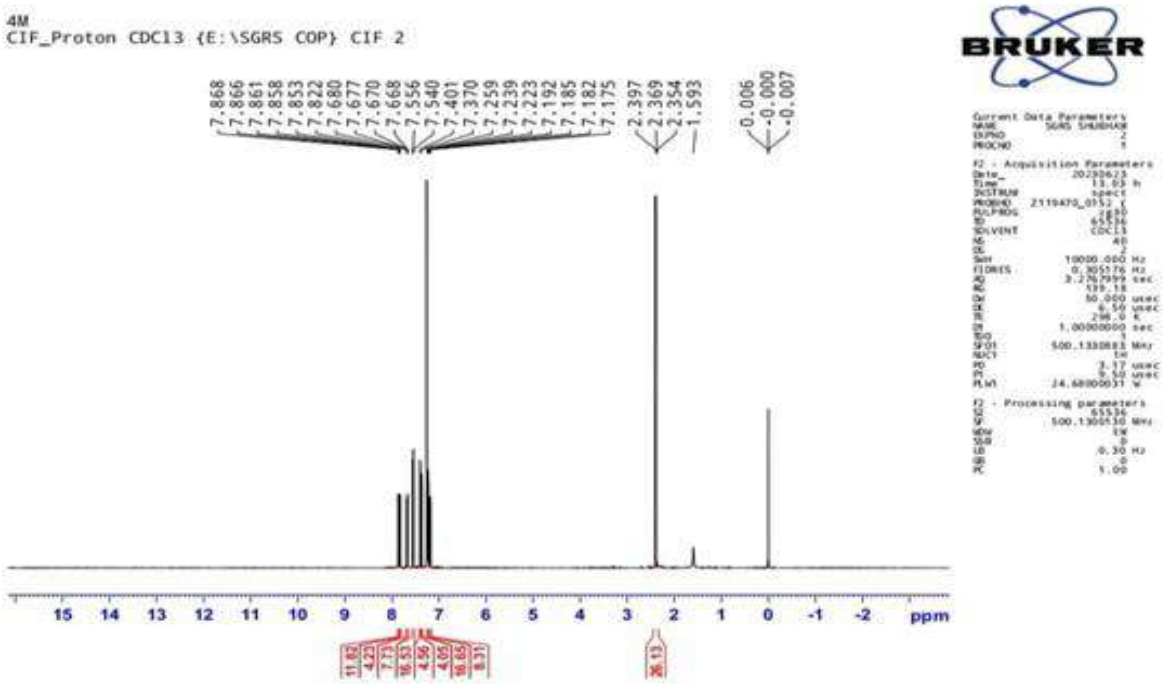
   IR (cm^{-1}): 1735 (C=O), 1636 (HC=CH), 686 (C-S) 855 (C-CL)

1. Mass spectrum: Mass spectra of: 3-(4-methylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one

Molecular weight 229.0689 was found.



1H NMR: 1HNMR spectral data of: 3-(4-methylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one.



(1). IR (cm-1): IR Spectral data of : 3-(4-methylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one.

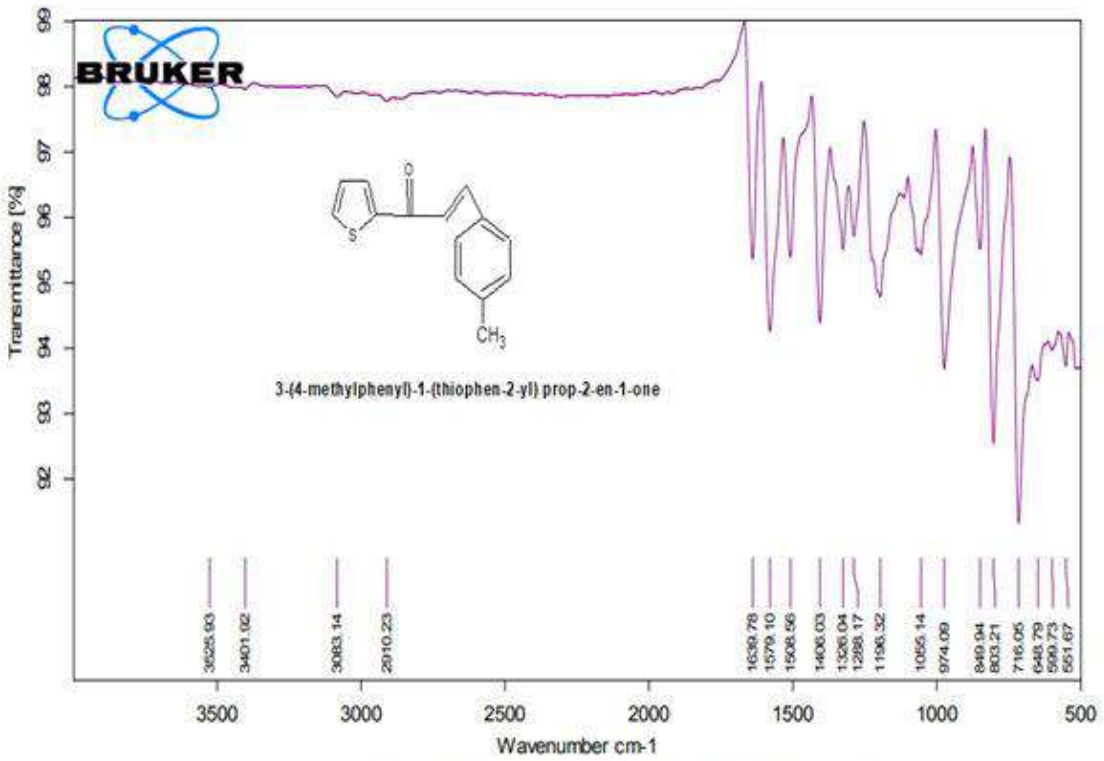


Figure 3- IR spectrum of 3-(4-methylphenyl)-1-(thiophen-2-yl) prop-2-en-1-one

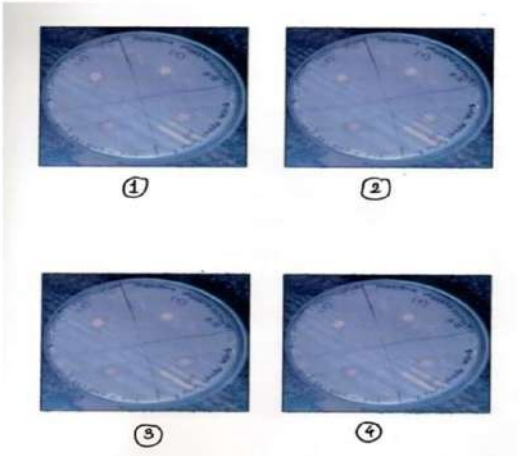
Anti-Microbial Activity

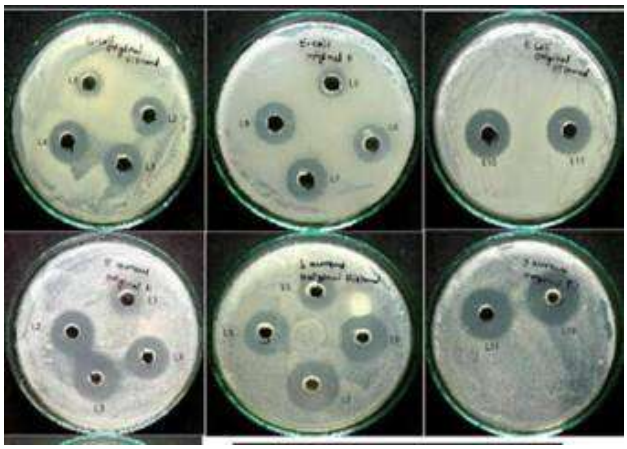
B-ketoesters are organic compounds that contain a carbonyl group (C=O) attached to a carbon atom that is adjacent to another carbon-carbon double bond (C=C). These compounds have been of interest in the field of medicinal chemistry due to their potential antimicrobial properties. The antimicrobial activity of β-ketoesters arises from their ability to interact with the microorganisms' cellular components, such as enzymes or cell membranes, leading to disruption of vital biological processes and ultimately killing or inhibiting the growth of the microorganisms. The synthesis of β-ketoesters typically involves the condensation reaction between β-keto acid or ester and an aldehyde or ketone. The resulting compound contains the β-ketoesters functional group. To assess the antimicrobial activity of synthesized β-ketoesters, various in vitro and in vivo assays can be performed. These assays involve exposing the target microorganisms, such as Xanthomonas Citri, Ervinia Carotovora, E. coli Proteas vulgerius, to different concentrations of the synthesized compounds and measuring their inhibitory effects on microbial growth. The specific mechanism of antimicrobial action can vary depending on the structure of the alpha β-ketoesters and the target microorganism. It may involve interference with enzymatic processes, inhibition of cell walls synthesis, disruption of cell membrane integrity, or interference with DNA replication. Experimental studies, including minimum inhibitory concentration (MIC) assays, time-kill kinetics, and zone of inhibition tests, are commonly employed to evaluate the antimicrobial activity of synthesized β-ketoesters. These studies help determine the effective concentration required to inhibit microbial growth, the rate of microbial killing over time, and the extent of growth inhibition in the vicinity of the compound.11,12,13 ,14.

RESULT AND DISCUSSION

Compounds	Xanthomonas Citri	Ervinia Carotovora	E. coli	Protease vulgerius
Compound -1	9 mm	10 mm	8 mm	9 mm
Compound -2	9 mm	10.5 mm	12 mm	-
Compound -3	-	9 mm	12 mm	8 mm
Compound -4	8 mm	9 mm	12.5 mm	9 mm
Compound -5	9 mm	12.5 mm	-	11mm
Compound -6	8 mm	9 mm	11.3 mm	-
Compound -7	9 mm	13 mm	-	7mm
Compound -8	9mm	7.5 mm	-	8mm
Compound-9	7mm	8mm	-	8mm

The synthesized αβ-unsaturated carbonyl compound (1 to 9) was tested against various gram+ve and gram-ve organisms (Xanthomo nas Citri, Ervinia Carotovora, E. coli Proteas vulgerius) and taken Ciprofloxacin as standard drug for comparison, compound 1,4-methylphenyl derivative of αβ-carbonyl compound was found more effective among all compounds. Compound 5 nitro derivative shows goodactivity against ProteaseVulgerius. Compound 7 ethoxy derivatives have shown good activity against Ervinia Carotovora.





CONCLUSION

A comparative study on the synthesis of αβ-unsaturated carbonyl compounds and their biological activity provides valuable information on the preparation of these compounds and their potential applications in the field of drug development. In addition, structure–activity relationship (SAR) studies have provided valuable information on key structural features that influence the pharmacological properties of β-ketoesters. Overall, a comparative study on the synthesis of αβ-unsaturated carbonyl compounds and their biological evaluation illuminates the potential applications of these compounds in drug development. The study provides a comprehensive overview of various synthetic methods, but also provides valuable insights into their biological properties and structure-activity relationships. Synthesis of α, β-unsaturated carbonyl compounds was carried out by Convectional and Microwave assisted synthesis. The Microwave assisted synthesis is proved to be superior ovesr convectional method because, less consumption of chemicals, good yield in short span of time. The antimicrobial activity was successfully carried out

and few compounds have shown good activity and eco-friendly.

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