# Synthesis, Antimicrobial Evaluation, and Molecular Docking Study of New Thiazole-5-phenylpropenone Derivatives

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P. S. Patil, S. L. Kasare, A. D. Badar, R. S. Kulkarni, P. P. Dixit, J. A. Kulkarni, P. B. Choudhari & K. P. Haval



## Abstract

A series of new (*E*)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-phenylprop-2-en-1-one derivatives have been synthesized starting from the antitubercular drug, ethionamide. The synthesized compounds have been tested for their *in vitro* antimicrobial

activity, and five of those have demonstrated promising activity. According to molecular docking study the active compounds have display high binding affinity towards DNA Gyrase and Lumazine Synthase.



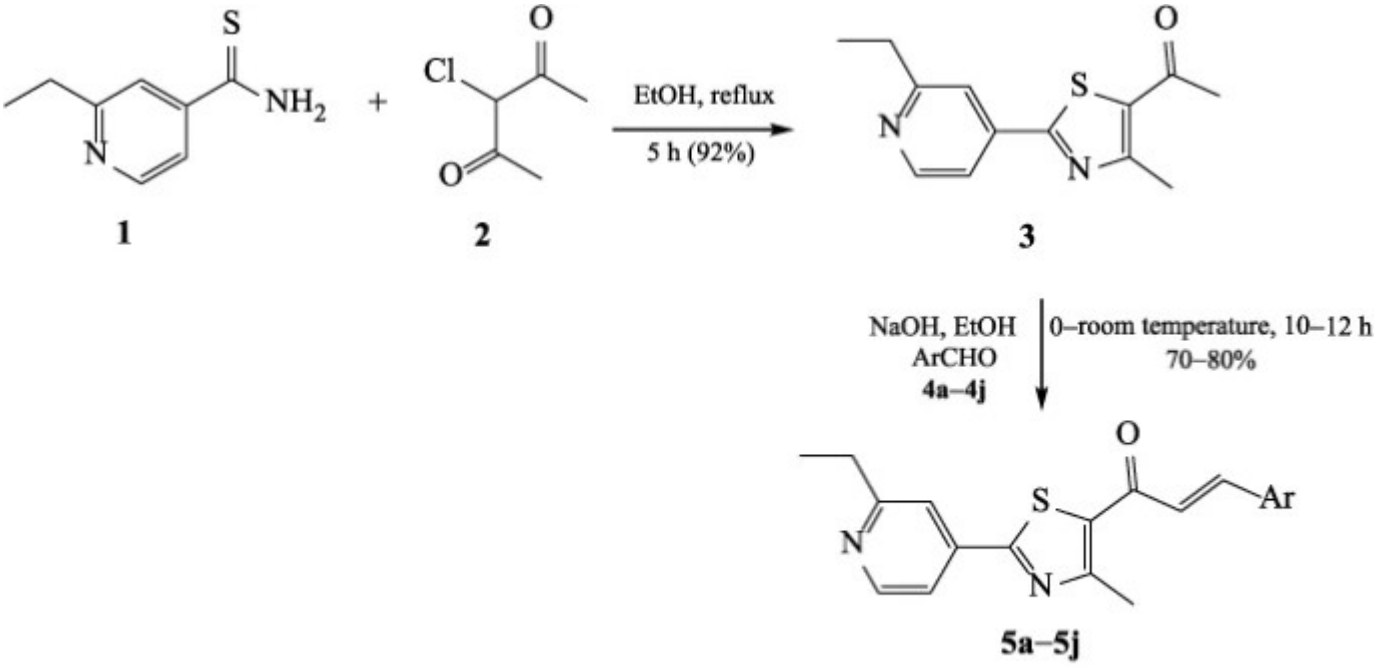
# INTRODUCTION

Chalcone derivatives have attracted close attention due to their broad spectrum of biological activities [1, 2] including antimicrobial, anticancer [3], antibacterial [4], and anti-tubercular [5]. Thiazole-chalcone hybrid molecules with antibacterial [6], anticancer [7–9], antioxidant [10], antimicrobial [11, 12], and many more have been reported. In view of the above observations and based on our earlier approaches to synthesis of pyridyl-thiazolyl clubbed bioactive compounds [13, 14], herein a new series of thiazole- 5-phenylpropenone derivatives have been synthesized and evaluated for their biological activities.

# RESULTS AND DISCUSSION

Synthesis of the target thiazole-5-phenylpropenone derivatives 5a–5j was accomplished as presented in Scheme 1. In the first step 2-ethylpyridine-4-carbothioamide (1) was reacted with 3-chloropentane-2,4-dione (2) to give formation of 1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]ethanone (3) with 92% yield. The following Claisen-Schmidt condensation of the intermediate 3 with various aromatic aldehydes 4a–4j under basic conditions furnished the corresponding chalcones 5a–5j with 70–80% yield.

**Scheme 1.**




Ar = 4-$ClC_6H_4$ (**5a**), 3-$NO_2C_6H_4$ (**5b**), 3-$ClC_6H_4$ (**5c**), 4-$FC_6H_4$ (**5d**), 3-$BrC_6H_4$ (**5e**), 4-$OCH_3C_6H_4$ (**5f**), 2-$BrC_6H_4$ (**5g**), furyl (**5h**), 4-$BrC_6H_4$ (**5i**), 4-$CH_3C_6H_4$ (**5j**).

Synthesis of thiazole-5-phenylpropenone derivatives 5a–5j.

Structures of the newly synthesized thiazole-5-phenylpropenone derivatives 5a–5j were elucidated from IR, $^1H$, and $^{13}C$ NMR, and HRMS spectra. In IR spectrum of compound 5a, the characteristic band at 1644 $cm^{-1}$ indicated the presence of α,β-unsaturated ketone. In $^1H$ NMR spectrum of 5a, a singlet at 2.88 ppm indicated $CH_3$ attached to thiazole ring. Two doublets of

vinylic protons were recorded at 7.22 and 7.77 ppm with coupling constants 15.6 and 15.2 Hz and indicated the *trans* conformation. $^{13}$C NMR and HRMS spectra also supported the structure assigned to (*E*)-3-(4-chlorophenyl)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]prop-2-en-1-one (5a).

The *in vitro* antimicrobial activity of newly synthesized thiazole-5-phenylpropenone derivatives 5a–5j was assessed by using agar well diffusion method [15]. Gram-positive pathogens *Staphylococcus aureus* ATCC6538, *Bacillus cereus* ATCC14579, *Bacillus subtilis* ATCC6633 and Gram-negative pathogens *Escherichia coli* ATCC8739, *Salmonella typhi* ATCC9207, *Shigella boydii* ATCC12034, *Enterobacter aerogenes* ATCC13048, *Pseudomonas aeruginosa* ATCC9027, and *Salmonella abony* NCTC6017 were involved in this study. Antifungal activity of synthesized compounds was determined against *Saccharomyces cerevisiae* ATCC9763, *Aspergillus niger* ATCC16404 and *Candida albicans* ATCC10231 fungal pathogens. Tetracycline and Fluconazole were used as antibacterial and antifungal standard reference compounds, respectively. The compounds 5b, 5e, 5f, 5g, and 5h demonstrated high antibacterial and antifungal activities (Table 1).

**Table 1. Antimicrobial activity of thiazole-5-phenylpropenone derivatives 5a–5j presented as zones of inhibition**

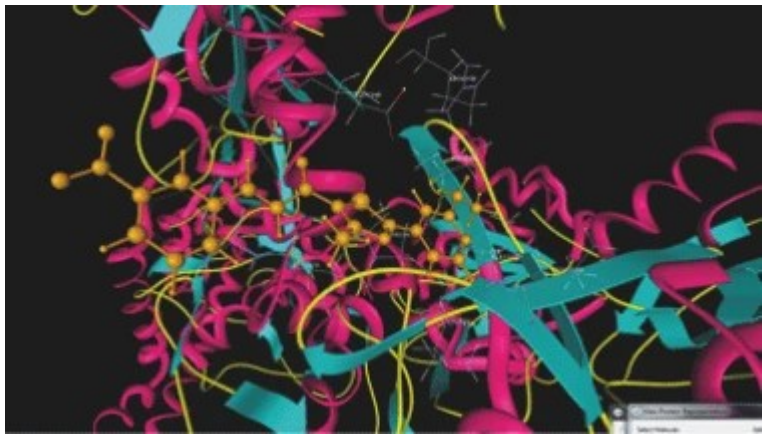
The MIC was determined for five most potent antimicrobial thiazole-5-phenylpropenone derivatives. All experiments were performed in triplicates, and results are expressed as mean ± SD in μg/mL (Table 2).

**Table 2. MIC determination of most potent antimicrobial derivatives**

Molecular docking was performed for the analysis of possible mode of action [16] of the synthesized molecules. Crystal structure of the DNA gyrase (PDB ID: 6QX1) was utilized for

the docking analysis. Compound 5b has exhibited hydrogen bond interactions with LEU345 and hydrophobic interactions with MET179, ILE336, PRO343, LYS344, LEU345, and Van-der-Waals interactions with ARG630, GLU634, ARG342, PRO343, LYS344, LEU345 (Fig. 1).

**Fig. 1.**



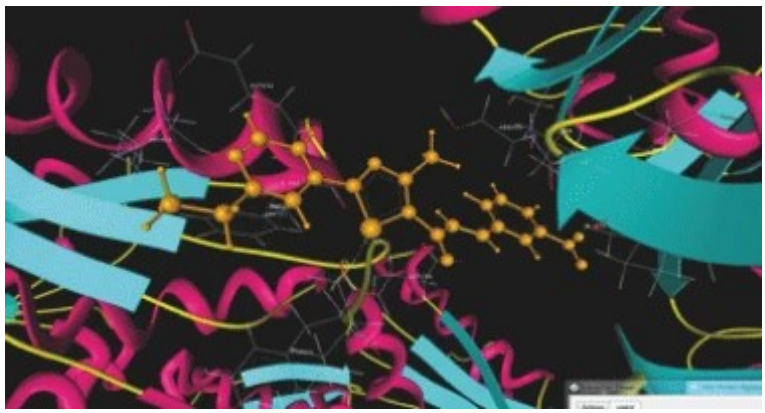
Docking interactions of 5b with DNA Gyrase.

Likewise, molecules of 5e could have hydrophobic interactions with ARG630, MET179, ILE336, PRO343 and Van-der-Waals interactions with ARG630, GLU634, MET179, ILE336, ARG342, PRO343, LYS344, LEU345. Molecule 5f has displayed interactions with DNA gyrase via H-bond with ARG630, hydrophobic interactions with ILE633, GLU634, ALA637, MET27, ILE30, PRO343, and Van-der-Waals interactions with ARG630, ILE633, GLU634, ALA637, MET27, ILE30, MET179, PRO343. Molecule 5g has shown H-bond interactions with ARG342 and hydrophobic interactions with GLU634, ALA637, MET27, VAL31, ARG342, and Van-der-Waals interactions with ILE633, GLU634, ALA637, MET27, VAL31, GLY341, ARG342. Molecule 5h has displayed H-bond with ARG630, hydrophobic interactions with ILE633, GLU634, ALA637, ARG342, PRO343, and Van-der-Waals interactions with ARG630, ILE633, GLU634, ALA637, ARG342.

Docking analysis was also performed against lumazine synthase [17]. The crystal structure of the lumazine synthase (PDB ID 2JFB) was downloaded from the free protein database www.rscb.org. Molecule 5b demonstrated H-bond interactions with LYS93, LYS12 and

aromatic interaction with PHE46, hydrophobic interactions with SER95, and Van-der-Waals interactions with LYS12, TYR13, ASP14, ARG42, GLU45, PHE46, LYS93, GLY94, SER95, MET97 (Fig. 2). Molecule 5e has displayed H-bond interactions with ARG42, LYS12 and aromatic interaction with PHE46, hydrophobic interaction with SER95, and Van-der-Waals interactions with LYS12, TYR13, ASP14, ARG42, GLU45, PHE46, LYS93, GLY94, SER95, MET97, LEU129.

**Fig. 2.**



Docking interactions of 5b with Lumazine Synthase.

ADME prediction. ADME predictions of thiazole-5-phenylpropenone derivatives were carried out using online portal www.swiss.adme.ch. All the synthesized molecules demonstrated the desired ADME properties indicating their potential as drug like candidates (Table 3).

**Table 3. ADME predictions of thiazole-5-phenylpropenone derivatives 5a–5j**

## EXPERIMENTAL

The laboratory grade chemicals were used. IR spectra (neat) were recorded on a Brukar FT-IR spectrophotometer. $^{1}H$ and $^{13}C$ NMR spectra were measured on a Brukar DRX-400 and Brukar DRX-100 NMR spectrometers, respectively, using $CDCl_3$ as a solvent and TMS as an internal

standard. High-resolution mass spectra were measured on a XEVO G2-XS QTOF mass spectrometer.

Synthesis of 1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]ethanone (3). A mixture of 2-ethylpyridine-4-carbothioamide (1) (2 mmol) with 3-chloropentane-2,4-dione (2) (2 mmol) was refluxed in ethanol. The progress of the reaction was monitored by TLC. After completion of the process, ethanol was evaporated under vacuum. The residue thus obtained was dissolved in ethyl acetate (50 mL) and neutralized by ammonia solution. The organic layer was washed with brine and dried over anhydrous sodium sulphate. Ethyl acetate was evaporated under vacuum, and the crude product was purified by column chromatography using ethyl acetate and petroleum ether to give pure compound 3. Yield 92%, mp 70–72°C. IR spectrum, ν, $cm^{-1}$: 3043, 2969, 1642, 1586, 1495, 1360, 1312, 1247, 1027, 949, 896, 728, 665. $^1H$ NMR spectrum, δ, ppm: 1.35 t (3H, *J* = 7.6 Hz, $CH_3$), 2.58 s (3H, $COCH_3$), 2.79 s (3H, thiazolyl-$CH_3$), 2.90 q (2H, *J* = 7.6 Hz, $CH_2$), 7.60 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.70 s (1H, pyridyl-H), 8.62 d (1H, *J* = 5.2 Hz, pyridyl-H). $^{13}C$ NMR spectrum, δ, ppm: 13.92, 18.54, 30.95, 31.55, 118.01, 118.86, 132.57, 139.94, 150.36, 159.82, 165.08, 166.82, 190.50.

Synthesis of (*E*)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-phenylprop-2-en-1-one derivatives (5a–5j). 1-[2-(2-Ethylpyridin-4-yl)-4-methylthiazol-5-yl]ethanone (3) (2 mmol) and the desired aromatic aldehyde 4a–4j were dissolved in ethanol (20 mL). Then, a solution of NaOH (2 mmol) in water (5 mL) was added drop wise at 0°C, and the reaction mixture was stirred at room temperature. The progress of the reactions were monitored by TLC. After completion of the process, the mixture was neutralized by HCl (10%). Ethanol was evaporated under vacuum. The reaction mixture was extracted with ethyl acetate. The organic layer was washed with brine and dried over anhydrous sodium sulphate. The obtained crude product was purified by column chromatography using ethyl acetate and petroleum ether to furnish the corresponding pure product 5a–5j.

(*E*)-3-(4-Chlorophenyl)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]prop-2-en-1-one (5a). Yield 75%, mp 115–117°C. IR spectrum, ν, $cm^{-1}$: 3031, 2919, 2855, 1644, 1589, 1477, 1362, 1194, 1079, 965, 811, 765. $^1H$ NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.88 s (3H, thiazolyl-$CH_3$), 2.90 q (2H, *J* = 7.6 Hz, $CH_2$), 7.22 d (1H, *J* = 15.6 Hz, vinyl-H), 7.40 d (2H, *J* = 8.4 Hz, Ar-H), 7.56 d (2H, *J* = 8.4 Hz, Ar-H), 7.62 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.74 s

(1H, pyridyl-H), 7.77 d (1H, *J* = 15.2 Hz, vinyl-H), 8.63 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.81, 18.65, 31.46, 117.90, 118.78, 124.61, 129.37, 129.76, 132.27, 132.75, 136.97, 139.84, 143.50, 150.28, 160.79, 165.01, 166.58, 182.15. HRMS (ESI): 369.0821 [*M* + H]$^+$. Calculated for $C_{20}H_{17}ClN_2OS$: 369.0784.

(*E*)-1-[2-(2-Ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-(3-nitrophenyl)prop-2-en-1-one (5b). Yield 80%, mp 92–94°C. IR spectrum, ν, cm$^{-1}$: 2920, 2855, 1729, 1655, 1484, 1361, 1293, 1194, 1978, 961, 840, 761. $^1$H NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.89 s (3H, thiazolyl-$CH_3$), 2.92 q (2H, *J* = 7.6 Hz, $CH_2$), 7.13 d (1H, *J* = 15.6 Hz, vinyl-H), 7.58–7.65 m (2H, Ar-H), 7.71–7.74 m (2H, Ar-H), 7.75 s (1H, pyridyl-H), 8.10 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 8.23 d (1H, *J* = 15.2 Hz, vinyl-H), 8.65 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.82, 18.69, 31.42, 117.97, 118.84, 125.17, 129.10, 129.24, 130.74, 130.75, 131.57,133.64, 139.81, 140.26, 148.62, 150.24, 161.41, 165.00, 166.94, 181.83.

(*E*)-3-(3-Chlorophenyl)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]prop-2-en-1-one (5c). Yield 77%, mp 90–92°C. IR spectrum, ν, cm$^{-1}$: 3047, 2938, 2854, 1648, 1590, 1465, 1360, 1081, 963, 820, 757. $^1$H NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.88 s (3H, thiazolyl-$CH_3$), 2.92 q (2H, *J* = 7.6 Hz, $CH_2$), 7.24 d (1H, *J* = 15.6 Hz, vinyl-H), 7.35–7.42 m (2H, Ar-H), 7.49 d (1H, *J* = 7.2 Hz, Ar-H), 7.59–7.62 m (1H, Ar-H), 7.65 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.75 s (1H, pyridyl-H), 7.76 d (1H, *J* = 15.2 Hz, vinyl-H), 8.66 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.83, 18.68, 31.44, 117.93, 118.81, 125.42, 127.03, 127.98, 130.33, 130.81, 132.14, 135.09, 136.08, 139.84, 143.25, 150.26, 161.00, 165.00, 166.67, 182.04.

(*E*)-1-[2-(2-Ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-(4-fluorophenyl)prop-2-en-1-one (5d). Yield 79%, mp 109–111°C. IR spectrum, ν, cm$^{-1}$: 3047, 2920, 2855, 1642, 1582, 1493, 1408, 1319, 1188, 1142, 1033, 977, 813. $^1$H NMR spectrum, δ, ppm: 1.38 t (3H, *J* = 7.6 Hz, $CH_3$), 2.89 s (3H, thiazolyl-$CH_3$), 2.93 q (2H, *J* = 7.6 Hz, $CH_2$), 7.11–7.16 m (2H, Ar-H), 7.20 d (1H, *J* = 15.6 Hz, vinyl-H), 7.63–7.66 m (3H, pyridyl and Ar-H), 7.75 s (1H, pyridyl-H), 7.80 d (1H, *J* = 15.2 Hz, vinyl-H), 8.66 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.97, 18.79, 31.60, 116.34, 116.56, 118.06, 118.93, 124.11, 130.70, 130.79, 140.02, 143.87, 150.41, 160.81, 165.14, 165.73, 166.65, 182.41.

(*E*)-3-(3-Bromophenyl)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]prop-2-en-1-one (5e). Yield 74%, mp 116–118°C. IR spectrum, ν, $cm^{-1}$: 2922, 2857, 1729, 1640, 1581, 1470, 1365, 1179, 967, 802. $^1H$ NMR spectrum, δ, ppm: 1.38 t (3H, *J* = 7.6 Hz, $CH_3$), 2.89 s (3H, thiazolyl-$CH_3$), 2.93 q (2H, *J* = 7.6 Hz, $CH_2$), 7.24 d (1H, *J* = 15.6 Hz, vinyl-H), 7.30–7.33 m (1H, Ar-H), 7.52–7.58 m (2H, Ar-H), 7.66 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.74 d (1H, *J* = 15.2 Hz, vinyl-H), 7.76 s (1H, pyridyl-H), 7.79 s (1H, Ar-H), 8.66 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}C$ NMR spectrum, δ, ppm: 13.98, 18.82, 31.57, 118.11, 118.99, 123.34, 125.57, 127.63, 130.72, 131.05, 132.27, 133.86, 136.50, 140.04, 143.32, 150.34, 161.19, 165.12, 166.77, 182.15.

(*E*)-1-[2-(2-Ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-(4-methoxyphenyl)prop-2-en-1-one (5f). Yield 70%, mp 103–105°C. IR spectrum, ν, $cm^{-1}$: 2920, 2855, 1732, 1638, 1553, 1499, 1458, 1427, 1365, 1298, 1253, 1171, 1082, 964, 812. $^1H$ NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.87 s (3H, thiazolyl-$CH_3$), 2.92 q (2H, *J* = 7.6 Hz, $CH_2$), 3.86 s (3H, $OCH_3$), 6.94 d (2H, *J* = 8.8 Hz, Ar-H), 7.14 d (1H, *J* = 15.2 Hz, vinyl-H), 7.60 d (2H, *J* = 6.8 Hz, Ar-H), 7.64 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.74 s (1H, pyridyl-H), 7.80 d (1H, *J* = 15.2 Hz, vinyl-H), 8.65 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}C$ NMR spectrum, δ, ppm: 13.96, 18.71, 31.55, 55.59, 114.65, 118.05, 118.91, 121.95, 127.12, 130.65, 132.92, 140.15, 145.05, 150.31, 160.25, 162.20, 165.04, 166.26, 182.61. HRMS (ESI): 365.1318 $[M + H]^+$. Calculated for $C_{21}H_{20}N_2O_2S$: 365.1279.

(*E*)-3-(2-Bromophenyl)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]prop-2-en-1-one (5g). Yield 78%, mp 110–112°C. IR spectrum, ν, $cm^{-1}$: 3011, 2921, 2855, 1732, 1648, 1565, 1481, 1360, 1146, 1021, 965, 813. $^1H$ NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.88 s (3H, thiazolyl-$CH_3$), 2.92 q (2H, *J* = 7.6 Hz, $CH_2$), 7.24 d (1H, *J* = 15.6 Hz, vinyl-H), 7.48–7.49 m (2H, Ar-H), 7.50–7.57 m (2H, Ar-H), 7.64 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.75 s (1H, pyridyl-H), 7.76 d (1H, *J* = 15.2 Hz, vinyl-H), 8.65 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}C$ NMR spectrum, δ, ppm: 13.96, 18.79, 31.60, 118.06, 118.93, 124.86, 125.52, 127.77, 130.08, 132.41, 132.49, 133.33, 139.99, 143.72, 150.41, 160.96, 165.16, 166.68, 166.75, 182.32. HRMS (ESI): 415.0267 $[M + H]^+$. Calculated for $C_{20}H_{17}BrN_2OS$: 415.0258.

(*E*)-1-[2-(2-Ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-(furan-2-yl)prop-2-en-1-one (5h). Yield 72%, mp 120–122°C. IR spectrum, ν, $cm^{-1}$: 3118, 2917, 2854, 1647, 1589, 1546, 1478, 1434, 1364, 1310, 1267, 1212, 1180, 1011, 957, 932, 824, 742. $^1H$ NMR spectrum, δ, ppm:

1.36 t (3H, *J* = 7.6 Hz, $CH_3$,), 2.86 s (3H, thiazolyl-$CH_3$), 2.91 q (2H, *J* = 7.6 Hz, $CH_2$), 6.52 d. d (1H, *J* = 2.0, 3.6 Hz, furyl-H), 6.75 d (1H, *J* = 3.2 Hz, furyl-H), 7.15 d (1H, *J* = 14.8 Hz, vinyl-H), 7.54 d (1H, *J* = 1.2 Hz, furyl-H), 7.57 d (1H, *J* = 15.2 Hz, vinyl-H), 7.62 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.74 s (1H, pyridyl-H), 8.63 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.95, 18.72, 31.51, 113.04, 117.44, 118.05, 118.91, 121.65, 130.79, 132.92, 140.12, 145.53, 150.27, 151.21, 160.44, 165.01, 166.45, 182.11. HRMS (ESI): 325.1012 [*M* + H]$^+$. Calculated for $C_{18}H_{16}N_2O_2S$: 325.0966.

(*E*)-3-(4-Bromophenyl)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]prop-2-en-1-one (5i). Yield 75%, mp 113–115. IR spectrum, ν, cm$^{-1}$: 2918, 2854, 1737, 1642, 1587, 1473, 1425, 1362, 1173, 1076, 964, 807. $^1$H NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.88 s (3H, thiazolyl-$CH_3$), 2.92 q (2H, *J* = 7.6 Hz, $CH_2$), 7.25 d (1H, *J* = 15.6 Hz, vinyl-H), 7.50 d (2H, *J* = 8.4 Hz, Ar-H), 7.57 d (2H, *J* = 8.4 Hz, Ar-H), 7.64 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.75 s (1H, pyridyl-H), 7.76 d (1H, *J* = 15.2 Hz, vinyl-H,), 8.65 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.97, 18.80, 31.60, 118.06, 118.93, 124.85, 125.52, 130.09, 132.41, 132.49, 133.31, 139.98, 143.73, 150.42, 160.97, 165.15, 166.75, 182.32.

(*E*)-1-[2-(2-Ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-(4-methylphenyl)prop-2-en-1-one (5j). Yield 72%, mp 85–87°C. IR spectrum, ν, cm$^{-1}$: 2920, 2856, 1740, 1637, 1579, 1455, 1365, 1316, 1183, 1080, 962, 801. $^1$H NMR spectrum, δ, ppm: 1.37 t (3H, *J* = 7.6 Hz, $CH_3$), 2.41 s (3H, Ph$CH_3$), 2.88 s (3H, thiazolyl-$CH_3$), 2.92 q (2H, *J* = 7.6 Hz, $CH_2$), 7.22 d (2H, *J* = 8.8 Hz, Ar-H), 7.23 d (1H, *J* = 15.6 Hz, vinyl-H), 7.54 d (2H, *J* = 8.4 Hz, Ar-H), 7.64 d. d (1H, *J* = 1.6, 5.2 Hz, pyridyl-H), 7.75 s (1H, pyridyl-H), 7.82 d (1H, *J* = 15.2 Hz, vinyl-H), 8.65 d (1H, *J* = 5.6 Hz, pyridyl-H). $^{13}$C NMR spectrum, δ, ppm: 13.97, 18.74, 21.75, 31.58, 118.07, 118.93, 123.34, 128.83, 129.96, 131.69, 132.78, 140.11, 141.87, 145.31, 150.36, 160.48, 165.09, 166.45, 182.72. HRMS (ESI): 349.1367 [*M* + H]$^+$. Calculated for $C_{21}H_{20}N_2OS$: 349.1330.

## CONCLUSIONS

A series of new (*E*)-1-[2-(2-ethylpyridin-4-yl)-4-methylthiazol-5-yl]-3-phenylprop-2-en-1-one derivatives 5a–5j is synthesized by the Claisen–Schmidt condensation reaction. The *in vitro* antimicrobial tests of the products by the diffusion method have indicated the

compounds 5b, 5e, 5f, 5g, and 5h as highly active. Molecular docking study demonstrates that the compounds can have good binding affinities towards DNA Gyrase and Lumazine Synthase. Thiazole-5-phenylpropenone derivatives have displayed the desired ADME properties. Accordingly, the new pyridyl and thiazolyl bearing chalcone structures have some potential in designing new antimicrobial agents.

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## Author information

### Authors and Affiliations

Department of Chemistry, Dr. Babasaheb Ambedkar Marathwada University SubCampus, 413501, Osmanabad, India
P. S. Patil, S. L. Kasare, A. D. Badar, R. S. Kulkarni & K. P. Haval

Department of Microbiology, Dr. Babasaheb Ambedkar Marathwada University SubCampus, 413501, Osmanabad, India
P. P. Dixit

Department of Biotechnology, Dr. Babasaheb Ambedkar Marathwada University SubCampus, 413501, Osmanabad, India
J. A. Kulkarni

Department of Pharmaceutical Chemistry, Bharati Vidyapeeth College of Pharmacy, 416013, Kolhapur, India
P. B. Choudhari

### Corresponding author

Correspondence to K. P. Haval.

## Ethics declarations

No conflict of interest was declared by the authors.

## Supplementary material

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