



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**

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EXPLORATION OF SUBSTITUTED PHENYL-TRIMETHOXY CHALCONE DERIVATIVES FOR POTENTIAL THERAPEUTIC APPLICATIONS

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Received 5th March 2026; Revised 8th April 2026; Accepted 15th June 2026; Available online 1st Nov. 2026

<https://doi.org/10.31032/IJBPAS/2026/15.11.10570>

ABSTRACT

Chalcone derivatives have attracted considerable interest due to their diverse pharmacological properties, particularly their antimicrobial potential. In the present study, a novel substituted phenyl-trimethoxy substituted chalcone derivatives were synthesized by green synthesis techniques and evaluated for its antibacterial activity against selected Gram-positive and Gram-negative bacterial strains. The compounds were synthesized through a Claisen-Schmidt condensation reaction and subsequently characterized using spectral techniques to confirm its chemical structure and functional groups. Spectral analysis indicated the successful formation of the chalcones framework along with the presence of the intended substituted phenyl trimethoxy chalcone derivatives.

The antibacterial activity of the synthesized compound was assessed using an agar diffusion method against representative Gram-positive and Gram-negative bacterial strains. The results demonstrated that the compounds exhibited appreciable antibacterial activity, producing distinct zones of inhibition against the tested organisms. The observed activity was comparable to that of the standard antibacterial drug used in the study.

The findings indicate that the substituted phenyl-trimethoxy chalcone derivatives synthesized via a green synthetic approach exhibited high purity and good percentage yield, and may serve as promising lead molecules for the development of novel antibacterial agents. Further studies involving structural modification and detailed biological evaluation are warranted to enhance their therapeutic potential.

Keywords: Chalcones, Claisen-Schmidt condensation, Acetophenone, Benzaldehyde

INTRODUCTION

Chalcones are an important class of compounds belonging to the flavonoid family and are characterized by an α , β -unsaturated carbonyl system linking two aromatic rings. Due to their simple structure and ease of synthesis, chalcone derivatives have attracted considerable attention in medicinal chemistry. These compounds are known to exhibit a wide range of biological activities, including antibacterial [1-2], antifungal [3-4], anti-inflammatory [5-6], analgesic [7-9] antioxidant [10], antidiabetic [11-13], antioxidant [14] and antiviral [15] properties.

The biological activity of chalcones can be significantly influenced by the presence of different substituents on the aromatic rings. In particular, methoxy-substituted chalcones, especially trimethoxy derivatives, have been widely investigated because methoxy groups can modify the electronic properties and lipophilicity of the molecule, thereby enhancing biological activity. In the present study, substituted phenyl-trimethoxy chalcone derivatives were synthesized and characterized, aiming to explore their potential pharmacological properties.

MATERIALS AND METHODS

All chemicals and reagents used in the study were of analytical grade and obtained from commercial suppliers including E. Merck

(Germany), Qualigens (India), Sigma-Aldrich (USA), and S.D. Fine Chemicals (India), and were used without further purification. The synthesized compounds were purified by recrystallization using suitable organic solvents. Melting points were determined by the open capillary method using a digital melting point apparatus and are uncorrected. Reaction progress and purity were monitored by thin-layer chromatography (TLC) on silica gel-G plates using appropriate solvent systems, with visualization under UV light and iodine vapors. Purity of the synthesized chalcone derivatives was further confirmed by HPLC using an Agilent analytical system. Elemental analysis was performed on a Euro EA 3000 elemental analyzer, and the experimental values were in good agreement with calculated values. Structural characterization was carried out using FT-IR spectroscopy (Bruker ALPHA) employing the KBr pellet method to identify the characteristic functional groups of the substituted phenyl-trimethoxy chalcone derivatives. Further structural confirmation was achieved through nuclear magnetic resonance (NMR) spectroscopy. ^1H NMR and ^{13}C NMR spectra were recorded in deuterated chloroform (CDCl_3) as solvent using a Bruker AC 400 MHz NMR spectrometer. The NMR spectra provided

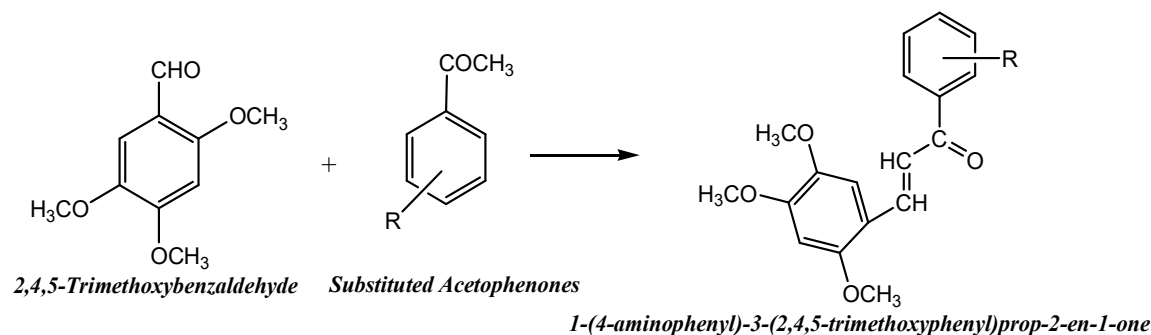
detailed information about the chemical environment of hydrogen and carbon atoms within the synthesized molecules, which helped in confirming the proposed structures of the substituted phenyl-trimethoxy chalcone derivatives.

Synthesis of Substituted Phenyl-Trimethoxy Chalcone Derivatives

The desired chalcone derivatives were synthesized via base-catalyzed Claisen–Schmidt condensation of 4-aminoacetophenone (0.01 mol) and 2,4,5-trimethoxybenzaldehyde (0.01 mol) in

ethanol (25 mL). Aqueous NaOH (10%, 5 mL) was added drop wise with continuous stirring, and the reaction mixture was stirred at room temperature for 6 h. The reaction progress was monitored by TLC using ethyl acetate:hexane (3:7). Upon completion, the mixture was poured into ice-cold water to precipitate the product. The resulting yellow solid was filtered, washed with water, dried, and purified by recrystallization from ethanol to obtain the chalcone derivative in pure crystalline form.

Scheme: Synthesis of Substituted Phenyl-Trimethoxy Chalcone Derivatives



3-(2,4,5-Trimethoxyphenyl)-1-phenylprop-2-en-1-one (PC-1): Yellow crystalline solid; yield 88 %; M.P 108–110 °C. Anal. Calcd for C₁₈H₁₈O₄; C, 69.00; H, 6.11; O, 4.47%. Found: C, 72.47; H, 6.08; O, 21.45. Mol. Wt.: 298.33. IR (KBr, cm⁻¹): 3360–3300 (N–H stretching of –NH₂), 3060 (aromatic C–H stretching), 2935–2840 (C–H stretching of –OCH₃), 1655 (α,β-unsaturated C=O stretching of chalcone), 1600–1585 (C=C aromatic and olefinic stretching), 1510 (aromatic skeletal

vibration), 1260–1210 (Ar–O–CH₃ stretching), 1030–1120 (C–O stretching of methoxy groups), 820–760 (aromatic C–H out-of-plane bending).

¹H NMR (400 MHz, CDCl₃, δ ppm): 3.78 (s, 3H, OCH₃), 3.83 (s, 3H, OCH₃), 3.86 (s, 3H, OCH₃), 5.20 (br s, 2H, NH₂), 6.72–6.90 (m, 3H, Ar–H of trimethoxyphenyl ring), 7.45 (d, J ≈ 15.5 Hz, 1H, CH=CH–CO), 7.58 (d, J ≈ 8.6 Hz, 2H, Ar–H), 7.78 (d, J ≈ 15.5 Hz, 1H, CH=CH–Ar), 7.92 (d, J ≈ 8.6 Hz, 2H, Ar–H).

^{13}C NMR (100 MHz, CDCl_3 , δ ppm): 189.7 (C=O), 151.0, 150.0, 142.0 (aromatic C–O carbons), 145.2 (β -olefinic carbon), 137.9 (aromatic quaternary carbon), 134.6, 129.9, 129.3 (aromatic CH carbons), 121.4 (α -olefinic carbon), 112.6, 108.3, 101.3 (aromatic carbons of trimethoxyphenyl ring), 56.3, 56.2, 56.2 (three $-\text{OCH}_3$ carbons).

1-(4-Aminophenyl)-3-(2,4,5-trimethoxyphenyl)prop-2-en-1-one (PC-2): Yellow solid; yield 82 %; M.P 168–170 °C Anal. Calcd for $\text{C}_{18}\text{H}_{19}\text{NO}_4$: C, 69.00; H, 6.11; N, 4.47% Found: C, 68.93; H, 6.08; N, 4.43%. Mol. Wt.: 313.35. IR (KBr, cm^{-1}): 3365, 3315 ($-\text{NH}_2$ stretching), 3062 (aromatic C–H), 2936, 2842 (aliphatic C–H of OCH_3), 1656 (α,β -unsaturated C=O), 1602, 1588 (C=C aromatic/olefinic), 1512 (aromatic skeletal vibration), 1265–1215 (Ar–O– CH_3 stretching), 1115–1035 (C–O stretching of methoxy groups), 832–760 (aromatic C–H out-of-plane bending).

^1H NMR (400 MHz, CDCl_3 , δ): 3.77 (s, 3H, OCH_3), 3.82 (s, 3H, OCH_3), 3.86 (s, 3H, OCH_3), 5.18 (br s, 2H, NH_2), 6.70 (s, 1H, Ar–H), 6.86 (s, 1H, Ar–H), 6.92 (s, 1H, Ar–H), 7.42 (d, $J = 15.6$ Hz, 1H, $\text{CH}=\text{CH}-\text{CO}$), 7.55 (d, $J = 8.6$ Hz, 2H, Ar–H), 7.76 (d, $J = 15.6$ Hz, 1H, $\text{CH}=\text{CH}-\text{Ar}$), 7.90 (d, $J = 8.6$ Hz, 2H, Ar–H).

^{13}C NMR (100 MHz, CDCl_3 , δ): 189.7 (C=O), 151.0, 150.0, 142.0 (Ar–C–O),

145.2 (β -olefinic C), 137.9 (aromatic quaternary C), 134.6, 129.9, 129.3 (aromatic CH), 121.4 (α -olefinic C), 112.6, 108.3, 101.3 (aromatic CH of trimethoxy ring), 56.3, 56.2, 56.2 (OCH_3).

1-(4-Chlorophenyl)-3-(2,4,5-trimethoxyphenyl)prop-2-en-1-one (PC-3): Yellow crystalline solid; yield 80 %; M.P 172–174 °C; Anal. Calcd for $\text{C}_{18}\text{H}_{17}\text{ClO}_4$: C, 65.76%; H, 5.21%. Found: C, 65.70%; H, 5.18%. Mol. Wt.: 332.78. IR (KBr, vmax cm^{-1}): 3060 (aromatic C–H stretching), 2955 and 2835 (aliphatic C–H stretching of $-\text{OCH}_3$), 1662 (strong, conjugated α,β -unsaturated C=O stretching), 1605 and 1512 (aromatic C=C stretching), 1575 (C=C of enone system), 1258 and 1218 (aryl–O– CH_3 stretching), 1175 and 1032 (C–O stretching of methoxy groups), 832 (para-disubstituted benzene C–H out-of-plane bending), and 760 (C–Cl stretching).

^1H NMR (δ ppm, CDCl_3): 3.82 (s, 3H, OCH_3), 3.86 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 6.52 (s, 1H, Ar–H of 2,4,5-trimethoxyphenyl ring), 6.68 (s, 1H, Ar–H of 2,4,5-trimethoxyphenyl ring), 7.42 (d, $J = 15.6$ Hz, 1H, α -olefinic H, $-\text{CO}-\text{CH}=\text{}$), 7.48 (d, $J = 8.6$ Hz, 2H, Ar–H, 4-chlorophenyl ring), 7.90 (d, $J = 8.6$ Hz, 2H, Ar–H, 4-chlorophenyl ring), 7.96 (d, $J = 15.6$ Hz, 1H, β -olefinic H, $-\text{CH}=\text{Ar}$).

^{13}C NMR (100 MHz, CDCl_3 , δ ppm): 189.5 (C=O), 151.2, 150.3, 149.8 (Ar–C–O),

144.6 (β -C), 136.8 (Ar-C-Cl), 134.9, 132.5 (Ar-Cq), 130.1, 129.4, 128.8 (Ar-CH), 121.7 (α -C), 113.0, 108.5, 101.6 (Ar-CH), 56.4, 56.2, 56.1 (OCH₃); Anal. Calcd for C₁₈H₁₈ClO₄: C, 65.76; H, 5.52%. Found: C, 65.70; H, 5.48%.

1-(4-Bromophenyl)-3-(2,4,5-trimethoxyphenyl)prop-2-en-1-one (PC-4): Pale yellow solid, yield 88%. M.P 152–154 °C. Anal. Calcd for C₁₈H₁₇BrO₄: C, 57.92; H, 4.59%. Found: C, 57.86; H, 4.55%. Mol. Wt.: 376.23. IR (KBr, cm⁻¹): 3056 (Ar-H stretching), 2935, 2838 (C-H stretching of OCH₃), 1658 (α,β -unsaturated C=O), 1604, 1587 (C=C aromatic/olefinic), 1512 (aromatic skeletal vibration), 1266–1212 (Ar-O-CH₃ stretching), 1122–1038 (C-O stretching), 840–760 (aromatic C-H bending), 620 (C-Br).

¹H NMR (400 MHz, CDCl₃, δ): 3.78 (s, 3H, OCH₃), 3.83 (s, 3H, OCH₃), 3.87 (s, 3H, OCH₃), 6.70 (s, 1H, Ar-H), 6.86 (s, 1H, Ar-H), 6.93 (s, 1H, Ar-H), 7.44 (d, J = 15.6 Hz, 1H, CH=CH-CO), 7.58 (d, J = 8.6 Hz, 2H, Ar-H), 7.74 (d, J = 15.6 Hz, 1H, CH=CH-Ar), 7.92 (d, J = 8.6 Hz, 2H, Ar-H).

¹³C NMR (100 MHz, CDCl₃, δ): 189.6 (C=O), 151.3, 150.4, 149.9 (Ar-C-O), 144.7 (β -olefinic C), 136.5 (Ar-C-Br), 134.8, 132.7 (aromatic quaternary carbons), 130.4, 129.6, 128.9 (aromatic CH), 121.6 (α -olefinic C), 113.1, 108.4, 101.5 (aromatic

CH of trimethoxyphenyl ring), 56.4, 56.3, 56.2 (OCH₃)

3-(2,4,5-Trimethoxyphenyl)-1-(4-methoxyphenyl)prop-2-en-1-one (PC-5):

White crystalline powder; yield 91 %; M.P 160–162 °C; Anal. Calcd for C₁₉H₂₀O₅: C, 69.50%; H, 6.14%. Found: C, 69.4%; H, 6.1%. Mol. Wt.: 328.13. IR (KBr, v_{max} cm⁻¹): The IR spectrum shows a strong absorption band at 1660–1680 cm⁻¹ corresponding to the C=O stretching of a conjugated carbonyl group. The aromatic C=C stretching bands appear at 1580–1600 cm⁻¹, while bands at 1240–1270 cm⁻¹ indicate aryl -O-CH₃ (methoxy) groups. The aromatic C-H stretching vibrations are observed around 3000–3050 cm⁻¹.

¹H NMR (400 MHz, CDCl₃): δ 7.82 (d, J $\approx$ 15.6 Hz, 1H, CH=CO), 7.58 (d, J $\approx$ 15.6 Hz, 1H, Ar-CH=), 7.92 (d, J $\approx$ 8.6 Hz, 2H, Ar-H), 6.96 (d, J $\approx$ 8.6 Hz, 2H, Ar-H), 6.75 (s, 2H, Ar-H), 3.86–3.92 (s, 12H, OCH₃).

¹³C NMR (100 MHz, CDCl₃, δ ppm): signals were observed at 188–190 ppm corresponding to the chalcone carbonyl carbon (C=O); 158–163 ppm for aromatic carbons attached to methoxy groups (Ar-O); 145–150 ppm for the β -olefinic carbon (C β); 120–130 ppm for the α -olefinic carbon (C α); 110–135 ppm for aromatic ring carbons, and 55–57 ppm corresponding to the methoxy (OCH₃) carbons.

4-3-(2,4,5-**Trimethoxyphenyl)acryloyl)benzamide**

(PC-6) : White powder; yield 90 %; M.P. 188–190 °C; Anal. Calcd for C₁₉H₁₉NO₅: C, 66.05; H, 5.23; N, 4.28%. Found: C, 65.9; H, 5.2; N, 4.3%. IR (KBr, $\nu_{\max}$ cm⁻¹): 3350–3200 (N–H stretching of amide), 1665–1675 (C=O stretching of conjugated ketone), 1635–1645 (amide C=O), 1600–1510 (aromatic C=C stretching), 1250–1270 (Ar–O–CH₃ stretching), 1020–1050 (C–O stretching of methoxy), 830–850 (aromatic C–H bending).

The ¹H NMR spectrum (400 MHz, CDCl₃, δ ppm) showed signals at δ 7.90 (d, J = 8.6 Hz, 2H, Ar–H) and 7.78 (d, J = 8.6 Hz, 2H, Ar–H) corresponding to the aromatic protons of the benzamide ring, 7.65 (d, J = 15.8 Hz, 1H, CH=CH) and 6.75.

¹³C NMR (100 MHz, CDCl₃, δ ppm): 189.7 (C=O), 168.1 (CONH), 151.0 (C), 150.0 (C), 145.2 (CH), 142.0 (C), 141.3 (C), 140.0 (C), 130.0 (CH), 130.0 (CH), 128.0 (CH), 128.0 (CH), 121.4 (CH), 112.6 (CH), 108.3 (C), 101.3 (CH), 56.3 (OCH₃), 56.2 (OCH₃), 56.2 (OCH₃).

1-(4-Hydroxyphenyl)-3-(2,4,5-**trimethoxyphenyl)prop-2-en-1-one (PC-**

7): White powder, yield 78%; M.P. 168–170 °C; Anal. Calcd for C₁₈H₁₈O₅: C, 68.78; H, 5.77%. Found: C, 68.6; H, 5.7%. IR (KBr, $\nu_{\max}$ cm⁻¹): 3320 corresponding to N–H stretching, 1665 corresponding to C=O

stretching of the carbonyl group, 1605 and 1510 corresponding to aromatic C=C stretching vibrations, and 1245 corresponding to C–O stretching of methoxy groups.

¹H NMR (400 MHz, CDCl₃, δ ppm): 7.85 (d, J = 8.4 Hz, 2H, Ar–H), 7.52 (t, J = 7.6 Hz, 1H, Ar–H), 7.32 (t, J = 7.2 Hz, 2H, Ar–H), 6.90 (s, 1H, olefinic H), 3.88 (s, 3H, OCH₃), and 3.85 (s, 6H, OCH₃).

¹³C NMR (100 MHz, CDCl₃, δ ppm): 189.7 (C=O), 164.3 (Ar–C–O), 151.0 (Ar–C), 150.0 (Ar–C), 145.2 (CH), 142.0 (Ar–C), 131.3 (Ar–CH), 131.3 (Ar–CH), 130.5 (Ar–C), 121.4 (CH), 116.4 (Ar–CH), 116.4 (Ar–CH), 112.6 (Ar–CH), 108.3 (Ar–C), 101.3 (Ar–CH), 56.3 (OCH₃), 56.2 (OCH₃), and 56.2 (OCH₃).

3-(2,4,5-trimethoxyphenyl)-1-(4-**nitrophenyl)prop-2-en-1-one (PC-8):**

Yellow crystalline solid; Yield: 82%; M.P.: 178–180 °C. Anal. Calcd for C₁₈H₁₈NO₆: C, 62.78; H, 5.27; N, 4.07. Found: C, 62.70; H, 5.31; N, 4.02. IR (KBr, cm⁻¹): 1660 (C=O, α,β -unsaturated ketone), 1602 (C=C, aromatic), 1515 and 1345 (NO₂ stretching), 1250–1030 (C–O stretching of methoxy groups), 3060 (Ar–H), 2925 (C–H, methoxy).

¹H NMR (400 MHz, CDCl₃, δ ppm) 3.78, 3.83, 3.89 (3s, 9H, OCH₃), 6.75 (s, 1H, Ar–H), 7.45 (d, J = 15.5 Hz, 1H), 7.70 (d, J = 8.6

Hz, 2H), 7.88 (d, J = 15.5 Hz, 1H), 8.25 (d, J = 8.6 Hz, 2H).

^{13}C NMR (100 MHz, CDCl_3 , δ ppm) 56.1, 56.4, 56.7, 104.5, 111.2, 118.6, 123.4, 127.8,

129.5, 134.2, 138.6, 145.3, 147.8, 151.5, 153.6, 189.5.

Table 1: Physical data of Substituted Phenyl-Trimethoxy Chalcone Derivatives

Compd	Substituent (-R)	M.F	M.W	M.P ($^{\circ}\text{C}$)	R _f
PC-1	-H	$\text{C}_{18}\text{H}_{18}\text{O}_4$	298.3	108-110	0.81
PC-2	$-\text{NH}_2$	$\text{C}_{18}\text{H}_{19}\text{NO}_4$	313.3	168-170	0.87
PC-3	$-\text{Cl}$	$\text{C}_{18}\text{H}_{17}\text{ClO}_4$	332.7	172-174	0.76
PC-4	$-\text{Br}$	$\text{C}_{18}\text{H}_{17}\text{BrO}_4$	376.2	152-154	0.65
PC-5	$-\text{OCH}_3$	$\text{C}_{19}\text{H}_{20}\text{O}_5$	328.1	160-162	0.88
PC-6	$-\text{CONH}_2$	$\text{C}_{19}\text{H}_{19}\text{NO}_5$	341.1	188-190	0.83
PC-7	$-\text{OH}$	$\text{C}_{18}\text{H}_{18}\text{O}_5$	314.3	168-170	0.78
PC-8	$-\text{NO}_2$	$\text{C}_{18}\text{H}_{18}\text{NO}_6$	344.4	178-180	0.82

ANTIMICROBIAL ACTIVITY

The antimicrobial activity of the synthesized compounds was evaluated against selected Gram-positive and Gram-negative bacterial strains such as *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Pseudomonas aeruginosa* by agar well diffusion method by using Ciprofloxacin as standard. The microbial cultures were obtained from a recognized microbial culture collection and maintained on nutrient agar slants at 4°C until use. The antifungal activity of the synthesized chalcone derivatives was evaluated by the agar well diffusion method against *Candida albicans* and *Aspergillus niger* by using Fluconazole as standard. DMSO is used as solvent control.

Antibacterial activity was evaluated using Mueller–Hinton agar prepared according to the manufacturer's instructions and sterilized at 121°C for 15 min. The medium was poured into sterile Petri plates and allowed to solidify. Fresh bacterial cultures

were prepared in nutrient broth and incubated at 37°C for 18–24 h, and the inoculum was adjusted to approximately 10^6 CFU/mL. The microbial suspension was uniformly spread on the agar surface using a sterile cotton swab. Wells (6 mm diameter) were made using a sterile cork borer, and the plates were allowed to stand for 30 min for diffusion before incubation at 37°C for 24 h for bacteria and $28\text{--}30^{\circ}\text{C}$ for 48 h for fungi

Preparation of test samples:

The synthesized compounds were dissolved in dimethyl sulfoxide (DMSO) to obtain a concentration of 1 mg/mL (or the desired concentration). The solutions were filtered through sterile membrane filters to maintain sterility.

About 50 & 100 μL of the test compound solution was introduced into each well using a micropipette. After incubation, the zones of inhibition were measured in millimeters (mm). The antimicrobial activity was evaluated by comparing the inhibition zones with those of the standard drugs.

Table 2: Antimicrobial evaluation of synthesized derivatives (Zone of inhibition in mm)

Compd	Conc (µg/ml)	<i>E. coli</i>	<i>S. aureus</i>	<i>B. subtilis</i>	<i>P. aeruginosa</i>	<i>C. albicans</i>	<i>A. niger</i>
PC-1	100	17.1	15.1	15.8	15.9	14.6	15.4
PC-2	100	18.4	18.7	18.6	18.4	17.8	18.1
PC-3	100	14.8	14.5	13.6	15.5	15.2	14.9
PC-4	100	14.5	14.5	14.2	14.7	15.4	15.3
PC-5	100	18.3	18.6	18.8	18.5	18.1	18.4
PC-6	100	17.2	15.2	16.7	15.8	14.8	15.7
PC-7	100	18.4	18.2	17.9	18.0	18.4	18.6
PC-8	100	15.0	15.3	14.8	14.5	15.1	14.6
Ciprofloxacin	10	24.2	26.1	25.5	23.4	--	--
Fluconazole	10	--	--	--	--	22.3	20.4
Control		00	00	00	00	00	00

RESULTS AND DISCUSSION:

The synthesized substituted phenyl-trimethoxy chalcone derivatives were evaluated for their antibacterial and antifungal activities using the agar well diffusion method against selected microbial strains. The antibacterial activity was tested against *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, and *Pseudomonas aeruginosa*, while antifungal activity was evaluated against *Candida albicans* and *Aspergillus niger*. Ciprofloxacin and Fluconazole were used as standard antibacterial and antifungal drugs, respectively.

The antimicrobial activity of the synthesized compounds was assessed by measuring the zones of inhibition (mm) after incubation. The results indicated that several compounds exhibited moderate to good antimicrobial activity against the tested microorganisms.

Among the tested derivatives, compounds bearing electron-donating substituents such as methoxy and hydroxy groups on the

aromatic ring showed comparatively higher activity against *Staphylococcus aureus* and *Bacillus subtilis*. Some derivatives also demonstrated noticeable inhibitory activity against the Gram-negative bacterium *Escherichia coli*, whereas relatively lower activity was observed against *Pseudomonas aeruginosa*.

In the antifungal screening, certain compounds exhibited significant inhibitory activity against *Candida albicans*, while moderate activity was observed against *Aspergillus niger*. The enhanced activity of some derivatives may be attributed to the presence of substituted aromatic rings and conjugated α,β -unsaturated carbonyl system, which is characteristic of chalcone derivatives and is known to contribute to antimicrobial activity.

Overall, the results suggest that structural modifications in the chalcone framework significantly influence antimicrobial potency, and some of the synthesized derivatives may serve as potential leads for

the development of new antimicrobial agents.

CONCLUSION:

The results revealed that several synthesized derivatives exhibited moderate to good antimicrobial activity, as indicated by the zones of inhibition. Derivatives containing electron-donating groups such as an amine, methoxy and hydroxy substituents (PC-2, PC-5 and PC-7) showed comparatively higher activity, particularly against *Staphylococcus aureus* and *Bacillus subtilis*. Some compounds also displayed activity against *Escherichia coli*, while lower activity was observed against *Pseudomonas aeruginosa*. In antifungal studies, certain derivatives showed significant activity against *Candida albicans* and moderate activity against *Aspergillus niger*.

The observed antimicrobial potential of these compounds may be attributed to the presence of substituted aromatic rings and the conjugated α,β -unsaturated carbonyl system, which are characteristic structural features of chalcone derivatives.

Acknowledgement:

The authors are grateful to the Management and Principal, Prof. Rama Rao Nadendla, Chalapathi Institute of Pharmaceutical Sciences, Lam, Guntur, for providing the necessary facilities and support to carry out this research work.

Conflict of Interest:

The authors declare that there is no conflict of interest regarding the publication of this research work.

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