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SYNTHESIS AND ANTIOXIDANT ACTIVITY OF SOME CHALCONES CONTAINING *N*-ARYLACETAMIDE GROUP

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Abstract: (*E*)-3-(4-chlorophenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one (**3a**) or (*E*)-3-(4-methoxyphenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one (**3b**) were prepared from reaction of 4-hydroxyacetophenone (**1**) and 4-chlorobenzaldehyde (**2a**) or 4-methoxybenzaldehyde (**2b**), respectively. The reaction of **3a** or **3b** and various *N*-aryl-2-chloroacetamides (**4a-d**) afforded eight new *N*-aryl-2-(4-(3-(4-substituted phenyl)acryloyl)phenoxy)acetamide compounds (**5a-h**). The structures of the compounds were confirmed by IR, ^{1}H-NMR, ^{13}C-NMR and HR-MS spectral data. Antioxidant activity performed by DPPH radical scavenging method showed that *N*-aryl-2-(4-(3-(4-substituted phenyl)acryloyl)phenoxy)acetamide compounds (**5a-h**) at a concentration of 10.0 μg/ mL possess antioxidant activity in equivalent to that of ascorbic acid at a concentration of 6.0-8.0 μg/ mL while the antioxidant activity of **3a** and **3b** compounds is higher that of ascorbic acid at the same concentration.

***Keywords*:** Acetamide, Antioxidant activity, Chalcones, 4-Chlorobenzaldehyde, 4-Hydroxyacetophenone, 4-Methoxybenzaldehyde

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Introduction

Chalcone is a common natural compound and one of the important intermediates in the biosynthesis of flavonoids. Chalcones also are important starting materials for the synthesis of biologically important heterocycles, such as pyrazolines,[1,2] isoxazolines,[2] benzodiazepines,[3] benzothiazepines,[4] etc. Some of the substituted chalcones and their derivatives have been reported to possess some interesting biological properties, including anti-inflammatory,[5] anticancer,[5-7] antioxidant,[8,9] antimicrobial[10] and anti-diabetic activities.[11] Besides that, compounds with phenoxy-*N*-arylacetamide scaffold have demonstrated a variety of biological activities such as antimicrobial,[12-15] antioxidant,[15,16] anticancer,[17,18] anti-inflammatory,[15,18] analgesic,[18,19] antipyretic,[18,19] and enzyme inhibitory,[20-25] HIV inhibitory[26] activities.

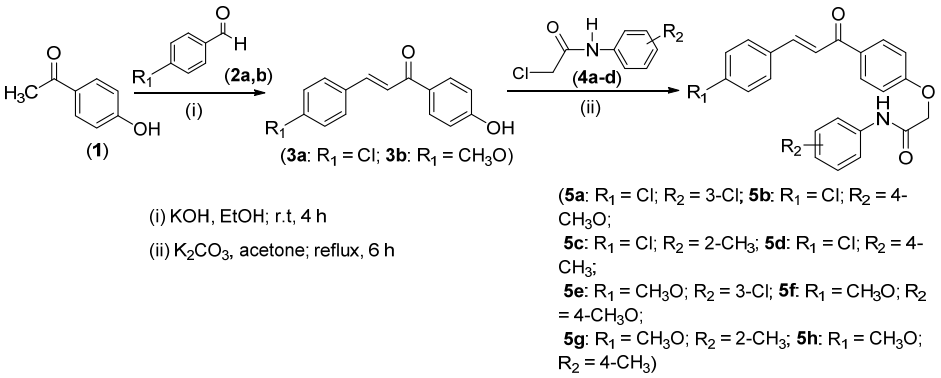
This paper described the preparation of chalcones containing phenoxy-*N*-arylacetamide scaffold and their antimicrobial activities to look for new useful compounds for pharmaceutical chemistry.

Results and Discussion

The reaction pathway for synthesis of *(E)*-*N*-aryl-2-(4-(3-(4-chloro/4-methoxyphenyl)acryloyl)phenoxy)acetamides (**4a-h**) is illustrated in Scheme 1.

The chalcones (**3a,b**) were prepared by the condensation of 4'-hydroxyacetophenone (**1**) with 4-chlorobenzaldehyde (**2a**) or 4-methoxybenzaldehyde (**2b**), respectively under alkaline conditions as described in the literature.[7,10] Physical properties and IR, ^{1}H-NMR spectral data of (**3a,b**) compounds are conformity with data in the literature.[7] In the IR spectra of the **3a** and **3b** compounds, the signal of the C=O group appeared in the low frequency near 1642 cm^{-1} because of the conjugation of the C=O and C=C bonds. Besides that, absorptions corresponding to bending vibrations appeared around 988 cm^{-1} in the spectra of these compounds indicated that (**3a,b**) were *trans*-alkenes. In the ^{1}H-NMR

spectra, the coupling between α-H (δ 7.86) and β-H (δ 8.08) with a *spin-spin* coupling constant (J = 17,0 Hz) indicated that both of chalcones (**3a,b**) exist in the (*E*)-configuration, which is in agreement with IR spectral data described above.



Scheme 1. The synthetic pathway.

N-aryl-2-chloroacetamides were synthesized according to the procedure described in our previous report.[13] In this procedure, *N*-aryl-2-chloroacetamides were obtained with high yield by acylation of corresponding substituted anilines by using chloroacetyl chloride as an acylation agent and acetic acid as a solvent.

Stirring mixture of a definite 4-hydroxychalcone (**3a** or **3b**) and a definite *N*-aryl-2-chloroacetamide (**4a** or **4b** or **4c** or **4d**) in acetone containing potassium carbonate gave corresponding substituted chalcones (**5a-h**).

The reaction belongs to the Williamson reaction type to prepare ethers from phenols and halogen derivatives. Mass spectra of the (**5a-h**) compounds showed the molecular peaks in agreement with their molecular formula. The IR, ^{1}H NMR, and ^{13}C-NMR spectra of the products are conformity with the proposed structures. In the IR spectra of the (**5a-h**) compounds, the stretching band at 3380 – 3415 cm^{-1} indicated the presence of the NH group while the strong band around 1690 cm^{-1} indicated the presence of an amide C=O group. In comparison to the ^{1}H-NMR spectra of

(**3a,b**), the spectra of (**5a-h**) compound appeared some extra signals in the aromatic area. Moreover, the signal of the CH_2 group as a *singlet* with the intensity of 2H at 4.73-4.88 ppm was seen easily. The ^{1}H-NMR spectra also showed the presence of vinylic protons near 7.70 ppm (Hα) and 7.80 ppm (Hβ) with a coupling constant $J_{ab} \approx 15.0$ Hz referred to *trans* conformation. In the ^{13}C-NMR spectra of (**5a-h**) compounds, the aliphatic carbon of the acetamide group showed a signal near 67.5 ppm.

Antioxidant capacity of chalcones (**3a,b**) and their acetamide derivatives (**5a-h**) was evaluated by 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging method.[27] This method is based on the spectrophotometric measurement of DPPH radical concentration changes resulting from the reaction of DPPH radical with an antioxidant. Ascorbic acid was used as a reference standard compound, and the experiment was done in triplicate. Table 1 below shows the absorbance (A) of the solution containing DPPH (2.85 mL) and ascorbic acid at different concentrations and inactivated DPPH percent (% I) caused by these solutions.

A standard curve was prepared using the different concentrations of DPPH radical. The following equation of calibration curve was used to calculate the level of DPPH radical in the reaction system: $y = 0.5137x + 6.499$. The DPPH radical scavenging capacities were calculated from the obtained calibration curve determined by linear regression ($R^2 = 0.9954$).

Table 1. Free radical scavenging activities of the Ascorbic acid.

Ascorbic acid (μg/mL)	2.0	4.0	6.0	8.0	10.0
A_1	0.939	0.787	0.681	0.578	0.455
A_2	0.933	0.798	0.683	0.553	0.544
A_3	0.912	0.800	0.680	0.566	0.434
$A_{average}$	0.928 ±0.16	0.795 ±0.01	0.681 ±0.00	0.566 ±0.01	0.478 ±0.06
I %	15.64	27.73	38.06	48.58	56.58

The radical scavenging activity of chalcones (**3a,b**) and their acetamide derivatives (**5a-h**) was expressed as inactivated DPPH percent (I %). These values were determined from the standard curve, and the results were shown in Table 2.

Table 2. The radical scavenging activities of (**3a,b**) and (**5a-h**) compounds.

Compounds	I (%) Mean ± SD	Compounds	I (%) Mean ± SD
3a	61.22 ± 4.32	**3b**	63.37 ± 3.53
5a	45.21 ± 2.67	**5e**	37.46 ± 3.22
5b	35.26 ± 4.21	**5f**	35.36 ± 2.11
5c	36.82 ± 3.16	**5g**	43.69 ± 3.18
5d	29.58 ± 3.22	**5h**	31.69 ± 1.16

The results indicated that the antioxidant activity of the chalcone compounds containing acetamide group (**5a-h**) at a concentration of 10.0 μg/mL was equivalent to that of ascorbic acid at a level of about 6.0 to 8.0 μg/mL. However, the original chalcones with the free hydroxyl group (without acetamide group) possessed higher antioxidant activity, exceeding the antioxidant activity of ascorbic acid at a concentration of 10.0 μg/mL. The reason may be that the free hydroxyl group stabilizes free radicals and thus increases the antioxidant capacity of these compounds. There was no significant difference in the antioxidant activity of **3a,** and it's derivatives in comparison to that of **3b** and it's derivatives.

Experimental

Melting points were determined on a Gallenkamp apparatus and were uncorrected. Infrared (IR) spectra were recorded on a Shimadzu FTIR-8400S spectrophotometer. Nuclear magnetic resonance (NMR) spectra were recorded on a Bruker Avance III spectrometer (500 MHz for ^{1}H NMR and 125 MHz for ^{13}C NMR) using residual solvent DMSO-d_6

signals as internal references. HR-MS experiments were performed using an Agilent Q-TOF 6500.

*Synthesis of (E)-3-aryl-1-(4-hydroxyphenyl)prop-2-en-1-one (**3**)*

To solution of 4.08 g (0.03 mol) 4-hydroxyacetophenone (**1**) in 60 mL methanol, 30 mL solution of potassium hydroxide 50% was slowly added while stirring for 15 minutes. To this solution, 0.03 mol 4-chlorobenzaldehyde (**2a**) or 4-methoxybenzaldehyde (**2b**) was added dropwise with continuous stirring for 30 minutes. The stirring was continued for another 24 h at room temperature, the mixture then was poured in ice-cold water further acidified with dilute HCl. The solid obtained was filtered, recrystallized from ethanol to afford **3a** (74 %) or **3b** (68 %) as yellow solid, respectively.

*(E)-3-(4-chlorophenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one (**3a**)*: m.p. 188,6 °C (Lit.[7]: 188-190 °C); IR (ν, cm^{-1}, KBr): 3062, 3010 (*broad*, OH, Csp^2–H), 1641 (C=O), 1582 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 6.92 (2H, *d*, *J* = 8.5, ArH), 7.50 (2H, *d*, *J* = 8.5, ArH), 7.67 (1H, *d*, *J* = 15.0, α-H), 7.90 (2H, *d*, *J* = 8.5, ArH), 7.93 (1H, *d*, *J* = 15.0, β-H), 8.09 (2H, *d*, *J* = 8.5, ArH), 10.45 (1H, *s*, OH).

*(E)-3-(4-methoxyphenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one (**3b**)*: m.p. 185,7 °C (Lit.[7]: 186-187 °C); IR (ν, cm^{-1}, KBr): 3113 (*broad*, OH), 1643 (C=O), 1595, 1555 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 3.81 (3H, *s*, CH_3O), 6.92 (2H, *d*, *J* = 8.0, ArH), 7.01 (2H, *d*, *J* = 8.5, ArH), 7.68 (1H, *d*, *J* = 15.0, α-H), 7.78 (1H, *d*, *J* = 15.0, β-H), 7.82 (2H, *d*, *J* = 8.0, ArH), 8.07 (2H, *d*, *J* = 8.5, ArH), 10.39 (1H, *s*, OH).

*Synthesis of N-aryl-2-chloroacetamide compounds (**4a-d**)*

2-Chloroacetyl chloride 6.74 g (~0.055 mol) was added dropwise to a solution of an appropriate aromatic amine (0.05 mol) in 20 mL glacial

acetic acid while cooling in ice-bath. After stirring in ice-bath for 30 min and then stirred for 1 h in room temperature, the reaction mixture was poured into 100 mL cold water containing 4.1 g (0.05 mol) sodium acetate. The precipitate was filtered, then washed with cold water and recrystallized from ethanol.

2-chloro-*N*-(3-chlorophenyl)acetamide (**4a**): white crystalline solid (8.83 g, 86.6%); mp: 106.2 ^{o}C (Lit.[26]: 106-108 ^{o}C);

2-chloro-*N*-(4-methoxyphenyl)acetamide (**4b**): brown crystalline solid (8.76 g, 87.8%); mp: 117.8 ^{o}C (Lit.[26]: 118-120 ^{o}C);

2-chloro-*N*-*o*-tolylacetamide (**4c**): pale brown crystalline solid (8.32 g, 90.7%); mp: 103.6 ^{o}C (Lit.[26]: 104-106 ^{o}C);

2-chloro-*N*-*p*-tolylacetamide (**4d**): white crystalline solid (8.25 g, 89.9%); mp: 174.5 ^{o}C (Lit.[26]: 174-176 ^{o}C).

*Synthesis of (E)-2-(4-(3-arylacryloyl)phenoxy)-N-arylacetamide (**5a-h**)*

Solution of an appropriate *N*-aryl 2-chloroacetamide (0.01 mole) (**4a** or **4b** or **4c** or **4d**) in acetone (10 mL) was added dropwise to stirred solution of a definite chalcone (**3a** or **3b**) (0.01 mol) and potassium carbonate (0.012 mol) in dry acetone (15 mL). The reaction mixture was refluxed with stirring for 6 hours and then cooled to room temperature. After pouring in ice-cold water, the separated solid was filtered and recrystallized from ethanol.

*(E)-2-(4-(3-(4-chlorophenyl)acryloyl)phenoxy)-N-(3-chlorophenyl)acetamide (**5a**)*: white needle crystals, yield 61 %; m.p. 192-193 °C, IR (ν, cm^{-1}, KBr): 3402 (N-H), 3076 (Csp^2–H), 2916 (Csp^3–H), 1676 and 1653 (C=O), 1595 and 1541 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 4.88 (2H, *s*, CH_2), 7.17 (3H, *m*, ArH), 7.38 (1H, *dd*, $J_1 = J_2 = 8.0$, ArH), 7.55 (3H, *m*, ArH), 7.71 (1H, *d*, $J = 16.0$, α-H),

7.85 (1H, *d*, *J* = 2.0, ArH), 7.96 (3H, *m*, ArH, β-H), 8.20 (2H, *d*, *J* = 8.5, ArH), 10.35 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 67.5, 115.2, 118.6, 119.6, 123.3, 124.0, 129.4, 131.0, 131.4, 133.5, 134.3, 135.4, 140.2, 142.3, 162.2, 166.9, 187.8; HR-MS calcd for $C_{23}H_{17}Cl_2NNaO_3$, 448.0483; found, 448.0472 $(M+Na)^+$.

*(E)-2-(4-(3-(4-chlorophenyl)acryloyl)phenoxy)-N-(4-methoxyphenyl)acetamide (**5b**)*: white needle crystals, yield 77 %; m.p. 226-227 °C, IR (ν, cm^{-1}, KBr): 3383 (N-H), 3078 (Csp^2–H), 2914 (Csp^3–H), 1672 and 1657 (C=O), 1599 and 1526 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 3.84 (3H, *s*, CH_3O), 4.73 (2H, *s*, CH_2), 6.93 (2H, *d*, *J* = 9.0, ArH), 7.13 (2H, *d*, *J* = 8.5, ArH), 7.43 (2H, *d*, *J* = 8.0, ArH), 7.51 (2H, *d*, *J* = 8.0, ArH), 7.54 (1H, *d*, *J* = 15.0, α-H), 7.61 (2H, *d*, *J* = 8.5, ArH), 7.80 (1H, *d*, *J* = 15.0, β-H), 8.11 (3H, *d*, *J* = 8.5, ArH and NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 55.5, 67.5, 114.3, 114.7, 122.0, 122.1, 129.3, 129.6, 131.1, 132.5, 136.5, 143.1, 157.0, 160.6, 188.3; HR-MS calcd for $C_{24}H_{20}ClNNaO_4$, 444.0979; found, 444.1031 $(M+Na)^+$.

*(E)-2-(4-(3-(4-chlorophenyl)acryloyl)phenoxy)-N-(2-methylphenyl)acetamide (**5c**)*: white needle crystals, yield 78 %; m.p. 189-190 °C, IR (ν, cm^{-1}, KBr): 3414 (N-H), 3053 (Csp^2–H), 2913 (Csp^3–H), 1680 and 1653 (C=O), 1593 and 1541 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 3.74 (3H, *s*, CH_3), 4.83 (2H, *s*, CH_2), 6.91 (2H, *d*, *J* = 8.5, ArH), 7.17 (2H, *d*, *J* = 9.0, ArH), 7.54 (4H, *m*, ArH), 7.71 (1H, *d*, *J* = 15.0, α-H), 7.93 (2H, *d*, *J* = 8.5, ArH), 7.99 (1H, *d*, *J* = 15.0, β-H), 8.20 (2H, *d*, *J* = 9.0, ArH), 10.03 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 55.7, 67.6, 114.4, 115.2, 121.8, 123.3, 129.4, 131.0, 131.3, 131.4, 131.9, 134.3, 135.4, 142.3, 156.1, 162.3, 166.0, 187.8; HR-MS calcd for $C_{24}H_{20}ClNNaO_3$, 428.1029; found, 428.1054 $(M+Na)^+$.

*(E)-2-(4-(3-(4-chlorophenyl)acryloyl)phenoxy)-N-(4-methylphenyl)acetamide (**5d**)*: white needle crystals, yield 89 %; m.p. 234-235 °C, IR (ν, cm^{-1}, KBr): 3393 (N-H), 3040 (Csp^2–H), 2918 (Csp^3–H), 1684 and 1649 (C=O), 1593 and 1530 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 2.27 (3H, *s*, CH_3), 4.84 (2H, *s*, CH_2), 7.14 (2H, *d*, *J* = 8.5, ArH), 7.17 (2H, *d*, *J* = 8.5, ArH), 7.53 (4H, *m*, ArH), 7.71 (1H, *d*, *J* = 15.0, α-H), 7.93 (2H, *d*, *J* = 8.5, ArH), 7.98 (1H, *d*, *J* = 15.0, β-H), 8.20 (2H, *d*, *J* = 8.5, ArH), 10.08 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 20.9, 67.6, 115.2, 120.2, 123.3, 129.4, 129.6, 131.0, 131.3, 131.4, 133.2, 134.3, 135.4, 136.3, 142.3, 162.3, 166.2, 187.8; HR-MS calcd for $C_{24}H_{21}ClNO_3$, 406.1210; found, 406.1240 $(M+H)^+$.

*(E)-2-(4-(3-(4-methoxyphenyl)acryloyl)phenoxy)-N-(3-chlorophenyl)acetamide (**5e**)*: white needle crystals, yield 66 %; m.p. 162-163 °C, IR (ν, cm^{-1}, KBr): 3404 (N-H), 3076 (Csp^2–H), 2930 (Csp^3–H), 1684 and 1653 (C=O), 1593 and 1508 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 3.83 (3H, *s*, CH_3), 4.88 (2H, *s*, CH_2), 7.02 (2H, *d*, *J* = 8.5, ArH), 7.16 (3H, *m*, ArH), 7.38 (1H, *dd*, $J_1 = J_2$ = 8.0, ArH), 7.56 (1H, *d*, *J* = 8.0, ArH), 7.70 (1H, *d*, *J* = 15.0, α-H), 7.82 (1H, *d*, *J* = 15.0, β-H), 7.84 (3H, *m*, ArH), 8.18 (2H, *d*, *J* = 8.5, ArH), 10.35 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 55.8, 67.5, 114.9, 115.2, 118.6, 119.7, 120.0, 124.0, 127.9, 131.0, 131.1, 131.2, 131.8, 133.6, 140.3, 143.7, 161.7, 162.0, 167.0, 187.8; HR-MS calcd for $C_{24}H_{20}ClNNaO_4$, 444.0979; found, 444.1032 $(M+Na)^+$.

*(E)-2-(4-(3-(4-methoxyphenyl)acryloyl)phenoxy)-N-(4-methoxyphenyl)acetamide (**5f**)*: white needle crystals, yield 65 %; m.p. 173-174 °C, IR (ν, cm^{-1}, KBr): 3402 and 3226 (N-H), 3072 (Csp^2–H), 2914 (Csp^3–H), 1684 and 1661 (C=O), 1597 and 1528 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 3.74 (3H, *s*, OCH_3), 3.83 (3H, *s*, OCH_3), 4.82 (2H,

s, CH_2), 6.92 (2H, *d*, *J* = 9.0, ArH), 7.02 (2H, *d*, *J* = 8.5, ArH), 7.16 (2H, *d*, *J* = 9.0, ArH), 7.56 (2H, *d*, *J* = 9.0, ArH), 7.70 (1H, *d*, *J* = 15.0, α-H), 7.82 (1H, *d*, *J* = 15.0, β-H), 7.85 (2H, *d*, *J* = 8.5, ArH), 8.18 (2H, *d*, *J* = 8.5, ArH), 10.03 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 55.7, 55.8, 67.6, 114.4, 114.9, 115.2, 120.0, 121.9, 127.9, 131.1, 131.2, 131.7, 131.9, 143.7, 156.1, 161.7, 162.1, 166.0, 187.8; HR-MS calcd for $C_{25}H_{23}NNaO_5$, 440.1474; found, 440.1463 $(M+Na)^+$.

*(E)-2-(4-(3-(4-methoxyphenyl)acryloyl)phenoxy)-N-(2-methylphenyl)acetamide (**5g**)*: white needle crystals, yield 71 %; m.p. 180-181 °C, IR (ν, cm^{-1}, KBr): 3408 and 3277 (N-H), 3067 (Csp^2–H), 2918 (Csp^3–H), 1668 (C=O), 1591 and 1533 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 2.27 (3H, *s*, CH_3), 3.89 (3H, *s*, OCH_3), 4.77 (2H, *s*, CH_2), 6.97 (2H, *d*, *J* = 8.5, ArH), 7.12 (3H, *m*, ArH), 7.24 (2H, *m*, ArH), 7.44 (1H, *d*, *J* = 15.0, α-H), 7.63 (2H, *d*, *J* = 9.0, ArH), 7.82 (1H, *d*, *J* = 15.0, β-H), 7.97 (1H, *d*, *J* = 8.5, ArH), 8.10 (2H, *d*, *J* = 9.0, ArH), 8.20 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 17.5, 55.4, 67.7, 114.5, 114.6, 119.3, 122.5, 125.6, 127.0, 127.7, 128.7, 130.2, 130.6, 131.0, 133.0, 134.6, 144.5, 136.3, 160.3, 161.7, 165.4, 188.6; HR-MS calcd for $C_{25}H_{23}NNaO_4$, 424.1525; found, 424.1563 $(M+Na)^+$.

*(E)-2-(4-(3-(4-methoxyphenyl)acryloyl)phenoxy)-N-(4-methylphenyl)acetamide (**5h**)*: white needle crystals, yield 70 %; m.p. 187-188 °C, IR (ν, cm^{-1}, KBr): 3401 (N-H), 3001 (Csp^2–H), 2918 (Csp^3–H), 1682 and 1645 (C=O), 1586 and 1530 (C=C); ^{1}H NMR (500 MHz, DMSO-d_6): δ 2.27 (3H, *s*, CH_3), 3.83 (3H, *s*, OCH_3), 4.83 (2H, *s*, CH_2), 7.02 (2H, *d*, *J* = 8.5, ArH), 7.14 (2H, *d*, *J* = 8.0, ArH), 7.15 (2H, *d*, *J* = 8.5, ArH), 7.53 (2H, *d*, *J* = 8.0, ArH), 7.70 (1H, *d*, *J* = 15.0, α-H), 7.82 (1H, *d*, *J* = 15.0, β-H), 7.85 (2H, *d*, *J* = 8.5, ArH), 8.18 (2H, *d*, *J* = 9.0, ArH), 10.08 (1H, *s*, NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 20.9, 55.9,

67.6, 114.9, 115.1, 120.0, 120.2, 127.9, 129.6, 131.1, 131.2, 131.7, 133.2, 136.3, 143.7, 161.7, 162.1, 166.3, 187.8; HR-MS calcd for $C_{25}H_{24}NO_4$, 402.1705; found, 402.1705 $(M+H)^+$.

Antioxidant activity

The antioxidant activity of chalcones compounds was determined by DPPH radical scavenging.[27] Briefly, 1.0 mL of ascorbic acid solution at concentrations of: 2.0; 4.0; 6.0; 8.0; 10.0 µg/mL was added to the test tubes. Then add 2.85 mL of DPPH solution at 40 µg/mL of concentration and shake well. Leave at room temperature in the dark for 30 minutes. Absorbance was measured at 517 nm. The results were shown in Table 1.

Then 10.0 µg/mL of concentration of different synthesized compounds was also prepared in methanol. All sample solutions, 1.0 mL of sample, was added 2.85 mL DPPH solution at 40 µg/mL of concentration. The test tubes were kept for 30 min in the dark to complete the reaction. The absorbance of each test tube was recorded at 517 nm on the UV–VIS spectrophotometer against methanol as a blank. The DPPH free radical scavenging activity (I%) was calculated using the following formula: $I\% = \frac{A_{std} - A_{sample}}{A_{std}} \cdot 100$

where: A_{std}: absorbance of the DPPH standard sample;

A_{sample}: the absorbance of the sample.

The results were shown in Table 2.

Conclusions

(*E*)-3-(4-chlorophenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one, (*E*)-3-(4-methoxyphenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one and eight new their *N*-aryl-2-(4-(3-(4-substituted phenyl)acryloyl)phenoxy)acetamide derivatives were synthesized. The structure of the compounds was confirmed by IR, ^{1}H-NMR, ^{13}C-NMR, and HR-MS spectral data. The antioxidant activity of *N*-aryl-2-(4-(3-(4-substituted phenyl)acryloyl)phenoxy)acetamide compounds is lower while the

antioxidant activity of both (*E*)-3-(4-chlorophenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one and (*E*)-3-(4-methoxyphenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one is higher in comparison to that of ascorbic acid at the same concentration.

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