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Utilization of *N*-aryl chloroacetamide reagents in the synthesis of new phenoxyacetamide, thiazolidin-4-one and thiophene derivatives

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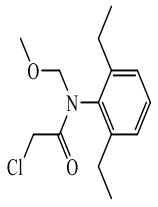
Abstract: *N*-Aryl chloroacetamide derivatives ($ArNHCOCH_2Cl$) were utilized as versatile precursors for the synthesis of various types of sulfides and phenoxy-acetamides, and two sulfur-containing heterocyclic systems (namely; thiophene and thiazole). The reaction of *N*-aryl chloroacetamides **1** with ethyl 2-mercaptoacetate furnished the conforming sulfide products **2a-e**. Treatment of **1** with ammonium thiocyanate yielded the conforming 2-(arylimino)thiazolidin-4-ones **4a-e**. Nucleophilic substitution of the chlorine atom from the *N*-aryl chloroacetamides **1** by the oxygen nucleophile of salicylaldehyde and/or 4-hydroxybenzaldehyde furnished the conforming 2-(formylphenoxy)-*N*-aryl-acetamides **5** and **6**. The condensation reaction of **6b** with thiosemicarbazide and/or *N*-(4-chlorophenyl)-2-cyanoacetamide yielded the expected products; thiosemicarbazone **7** and acrylamide **8**, respectively. The reaction of 2-acetyl-3-oxo-*N*-phenylbutanethioamide **(9)** with chloroacetamide and/or *N*-aryl chloroacetamides **1** was explored in sodium ethoxide and the products were identified as 4-acetyl-5-(phenylamino)thiophenes **11** and **12**. While, when the reaction carried out in boiling ethanol and triethylamine, the cyclization behaved opposite direction to produce 3-(5-oxo-3-phenylthiazolidin-2-ylidene)pentane-2,4-dione **(13)**.

keywords: Chloroacetamide, *N*-Aryl chloroacetamides, Salicylaldehyde, Ammonium thiocyanate, 4-Acetylthiophenes.

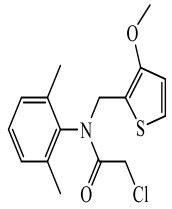
1.Introduction

Halogenated acid derivatives gained much attention because of their promising acidity that eliminate or inhibit the development of bacteria, fungi, parasites or viruses [1,2]. *N*-Aryl 2-chloroacetamides acts as antimicrobial agents such as herbicides, antifungal, disinfectant. Examples of 2-chloroacetamides which acts as herbicides such as 2-chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl)acetamide **(a)** and 2-chloro-N-(2,6-dimethyl-phenyl)-*N*-[(3-methoxy-2-thienyl) methyl] acetamide **(b)** are shown in Figure (1) [3,4]. The ease replacement of chlorine atom and reactive N-H group of chloroacetamide and its *N*-substituted derivatives makes them highly versatile synthetic reagents for the synthesis of aziridine [5], N-lactam [6], piperazine [7], imidazolidine containing compounds [8] and macrocyclic ligands [9]. 2-Chloroacetamide reagents were applied in the field of solid-state chemistry [10], natural and pharmacologically promising compounds [11-13] and biomarkers [14]. In continuation of our previous literature in the chemistry of *N*-aryl(heteroaryl)-2-chloroacetamides derivatives [15,16], herein we report on the reactivity of 2-chloroacetamide reagents towards various types of sulfur and oxygen nucleophiles (ethyl 2-mercaptoacetate, ammonium thiocyanate, hydroxybenzaldehyde and 2-acetyl-3-oxo-*N*-phenylbutanethioamide).



2-chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl)acetamide

(a)



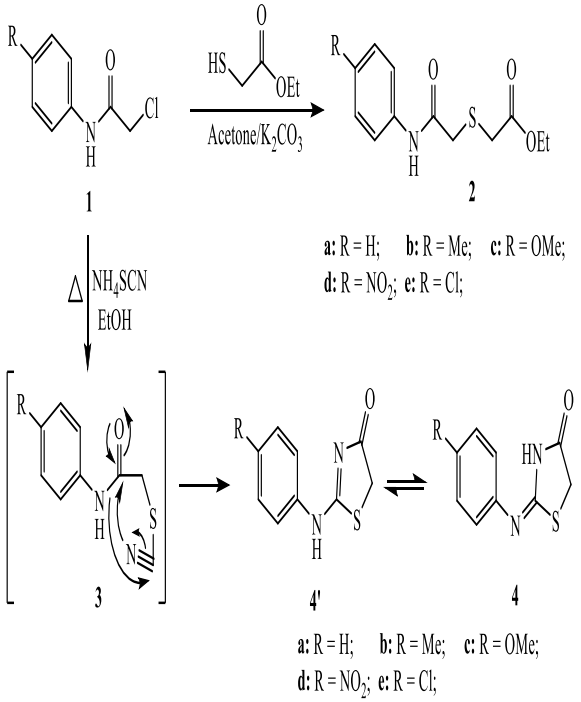
2-chloro-*N*-(2,6-dimethylphenyl)-*N*-((3-methoxy-thiophen-2-yl)methyl)acetamide

(b)

Fig (1): Examples of 2-chloroacetamide herbicides

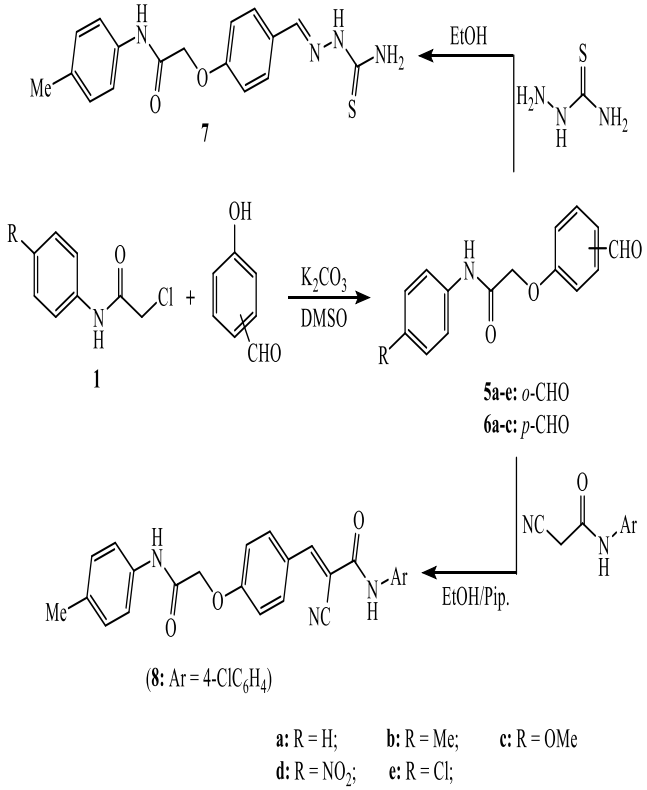
Results and discussion

The reaction of *N*-aryl chloroacetamide derivatives **1** with ethyl 2-mercaptoacetate (sulfur nucleophile) was performed by stirring in acetone and potassium carbonate to give the target sulfides, ethyl 2-((2-arylamino-ethyl-2-oxo)thio)acetates **2** (Scheme 1). Heterocyclization of *N*-aryl chloroacetamide derivatives **1** upon treatment with ammonium thiocyanate has been achieved by refluxing in ethanol for 4 hours to generate the conforming 2-(arylimino)thiazolidin-4-ones **4a-e** [17].



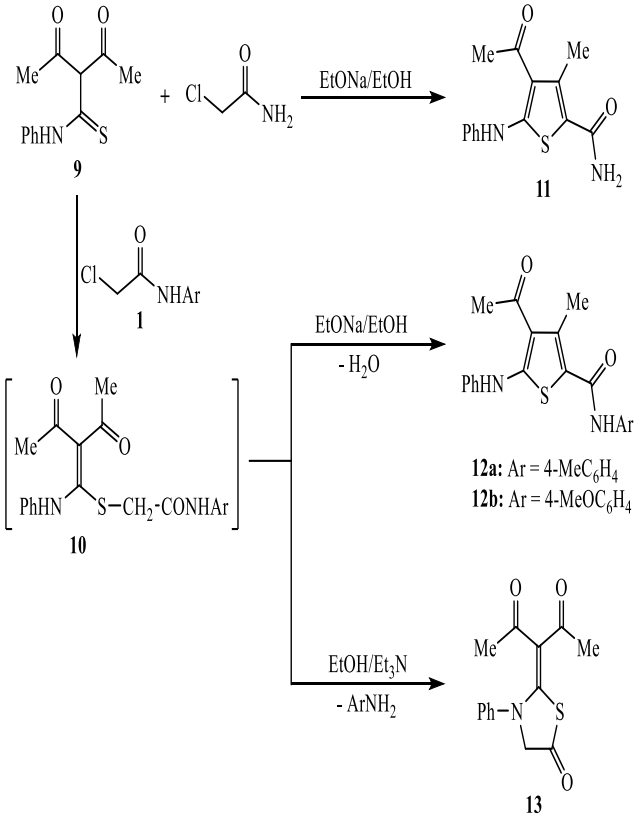
Scheme (1)

Nucleophilic substitution of the chlorine atom from the *N*-aryl chloroacetamide derivatives **1** by oxygen nucleophiles (namely; salicylaldehyde and/or 4-hydroxybenzaldehyde) proceeded by stirring in DMSO containing potassium carbonate for 4 hours to generate the conforming 2-(formylphenoxy)-*N*-aryl-acetamides **5** and **6** (Scheme 2). The reactivity of the formyl function in 2-(4-formylphenoxy)-*N*-aryl-acetamides **6** was explored. The condensation reaction of 2-(4-formylphenoxy)-*N*-(*p*-tolyl)-acetamide **(6b)** with thiosemicarbazide to yield the expected thiosemicarbazone, 2-(4-((2-carbamothioyl-hydrazineylidene)methyl)phenoxy)-*N*-(*p*-tolyl)acetamide **(7)** requires boiling in ethanol only. Heating of 2-(4-formylphenoxy)-*N*-(*p*-tolyl)-acetamide **(6b)** with *N*-(4-chlorophenyl)-2-cyanoacetamide in ethyl alcohol and piperidine affected elimination of water molecule (Knoevenagel reaction type) to furnish the conforming condensation product, *N*-(4-chlorophenyl)-2-cyano-3-(4-(2-oxo-2-(p-tolylamino)-ethoxy)phenyl)acrylamide **(8)**.



Scheme (2)

The chemical reactivity of 2-acetyl-3-oxo-*N*-phenylbutanethioamide **(9)** [18] towards chloroacetamide derivatives **1** was investigated. Fortunately, the nature of heterocyclic ring that formed (either thiophene or thiazolidin-5-one) mainly depends on the reaction condition. Firstly, the reaction of **9** with chloroacetamide and/or *N*-aryl chloroacetamide derivatives **1** was explored in boiling ethanolic solution of sodium ethoxide. The reaction starts via nucleophilic substitution of the chlorine atom followed by intramolecular elimination of ethanol molecule from the sulfide intermediate **10** to furnish the conforming 4-acetyl-2-carbamoyl-3-methyl-5-(phenylamino)thiophene **(11)** and its corresponding 4-acetyl-2-(*N*-arylcarbamoyl)-3-methyl-5-(phenylamino)-thiophenes **12** (Scheme 3). On the other hand, when the same reaction carried out in boiling ethanol in the presence triethylamine, the cyclization affected elimination of aryl amine molecule to give 3-(5-oxo-3-phenylthiazolidin-2-ylidene)pentane-2,4-dione **(13)**.



Scheme (3)

Experimental

Melting points were measured in degree centigrade on Gallenkamp apparatus and are uncorrected. The IR spectra were recorded (KBr) on Thermo Scientific Nicolet iS10 FTIR spectrometer. ^{1}H NMR spectra were measured in $CDCl_3$ or DMSO-d_6 as a solvent at 500 MHz on JEOL's NMR spectrometer using TMS as internal standard and chemical shifts are expressed as δ/ppm. Perkin-Elmer 2400 analyzer has been utilized to measure the elemental analyses.

(1) Synthesis of ethyl 2-((2-oxo-2-arylamino-ethyl)thio)acetates 2a-e:

To a stirred suspension of *N*-aryl chloroacetamide derivatives **(1)** (0.002 mol) and potassium carbonate (0.002 mol, 0.27 g) in acetone 15 mL, ethyl 2-mercaptoacetate (0.002 mol, 0.24 mL) was added. The reaction mixture was stirred at 30-35°C for 4 hours. The reaction mixture was poured into 20 g crushed ice and water. The product that formed was extracted by ethyl acetate using separating funnel to give the conforming sulfide from **2a** to **2e**.

Ethyl2((2oxo2(phenylamino)ethyl)thio)acetate (2a): IR (KBr): 3298 (NH), 1727, 1668 cm^{-1} (C=O).

Ethyl.2((2oxo2(*p*tolylamino)ethyl)thio)acetate (2b): IR (KBr): 3298 (NH), 1730, 1663 cm^{-1} (C=O).

Ethyl 2-((2-((4-methoxyphenyl)amino)-2-oxoethyl)thio)acetate (2c): IR (KBr): 3307 (NH), 1730, 1663 cm^{-1} (C=O). ^{1}H NMR (500 MHz, $CDCl_3$) δ/ppm = 1.24 (t, *J* = 7.25 Hz, 3H, CH_3), 3.35 (s, 2H, CH_2), 3.44 (s, 2H, CH_2), 3.78 (s, 3H, OCH_3), 4.15 (q, *J* = 7.25 Hz, 2H, CH_2), 6.85 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.48 (d, *J* = 9.00 Hz, 2H, Ar-H), 8.76 (s, 1H, NH).

Ethyl.2-((2-((4-nitrophenyl)amino)-2-oxoethyl)thio)acetate (2d): IR (KBr): 3303 (NH), 1734, 1671 cm^{-1} (C=O).

Ethyl.2-((2-((4-chlorophenyl)amino)-2-oxoethyl)thio)acetate (2e): IR (KBr): 3303 (NH), 1728, 1665 cm^{-1} (C=O).

(2) Synthesis of 2-(arylimino)thiazolidin-4-ones 4a-e:

To a solution of *N*-aryl chloroacetamide derivatives **(1)** (0.002 mol) in ethanol (40 mL), ammonium thiocyanate (0.003 mol, 0.22 g) was added and then refluxed for 4 hours. The reaction mixture was cooled to room temperature and the solid product **4a-e** that obtained in each case by separated by filtration and dried.

2-(Phenylimino)thiazolidin-4-one (4a): IR (KBr): 3259, 3202 (N-H), 1657 (C=O), 1610 cm^{-1} (C=N). Isomer **4'** (amino-form): ^{1}H NMR (DMSO-d_6): 3.99 (s, 2H, thiazolidinone-CH_2), 6.98 (d, *J* = 7.00 Hz, 2H, Ar-H), 7.14 (t, *J* = 7.00 Hz, 1H, Ar-H), 7.68 (d, *J* = 8.00 Hz, 2H, Ar-H), 11.16 (s, 1H, NH). Isomer **4** (imino-form): ^{1}H NMR (DMSO-d_6): 3.95 (s, 2H, thiazolidinone-CH_2), 7.14 (t, *J* = 7.00 Hz, 1H, Ar-H), 7.35-7.37 (m, 4H, Ar-H), 11.62 ppm (s, 1H, NH).

2-(*p*-Tolylimino)thiazolidin-4-one (4b): IR (KBr): 3267, 3203 (N-H), 1675 (C=O), 1635 cm^{-1} (C=N). Isomer **4'** (amino-form): ^{1}H NMR (DMSO-d_6): 3.26 (s, 3H, CH_3), 3.97 (s, 2H, thiazolidinone-CH_2), 6.91 (d, *J* = 7.50 Hz, 2H, Ar-H), 7.58 (d, *J* = 8.00 Hz, 2H, Ar-H), 11.17 (s, 1H, NH). Isomer **4** (imino-form): ^{1}H NMR (DMSO-d_6): 2.26 (s, 3H, CH_3), 3.93 (s, 2H, thiazolidinone-CH_2), 7.01-7.18 (m, 4H, Ar-H), 11.66 (s, 1H, NH).

2-(*p*-Anisylimino)thiazolidin-4-one (4c): IR (KBr): 3267, 3208 (N-H), 1672 (C=O), 1640

cm^{-1} (C=N). Isomer **4'** (amino-form): ^{1}H NMR (DMSO-d_6): 3.73 (s, 3H, OCH_3), 3.97 (s, 2H, thiazolidinone-CH_2), 6.91-6.95 (m, 4H, Ar-H), 11.03 (s, 1H, NH). Isomer **4** (imino-form): ^{1}H NMR (DMSO-d_6): 3.73 (s, 3H, OCH_3), 3.92 (s, 2H, thiazolidinone-CH_2), 6.99 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.58 (d, *J* = 9.00 Hz, 2H, Ar-H), 11.56 (s, 1H, NH).

2-((4-Nitrophenyl)imino)thiazolidin-4-one (4d): IR (KBr): 3272, 3225 (N-H), 1686 (C=O), 1633 cm^{-1} (C=N). Isomer **4'** (amino-form): ^{1}H NMR (DMSO-d_6): 4.16 (s, 2H, thiazolidinone-CH_2), 7.60 (d, *J* = 9.00 Hz, 2H, Ar-H), 8.32 (d, *J* = 9.00 Hz, 2H, Ar-H), 9.46 ppm (s, 1H, NH). Isomer **4** (imino-form): ^{1}H NMR (DMSO-d_6): 4.05 (s, 2H, thiazolidinone-CH_2), 7.08-7.18 (m, 2H, Ar-H), 8.22-8.25 (m, 2H, Ar-H), 11.86-12.01 ppm (s, 1H, NH).

2-((4-Chlorophenyl)imino)thiazolidin-4-one (4e): IR (KBr): 3270, 3200 (N-H), 1675 (C=O), 1638 cm^{-1} (C=N). Isomer **4'** (amino-form): ^{1}H NMR (DMSO-d_6): 3.98 (s, 2H, thiazolidinone-CH_2), 6.96 (d, *J* = 7.50 Hz, 2H, Ar-H), 7.78 (d, *J* = 8.50 Hz, 2H, Ar-H), 11.66 ppm (s, 1H, NH). Isomer **4** (imino-form): ^{1}H NMR (DMSO-d_6): 3.98 (s, 2H, thiazolidinone-CH_2), 7.23 (s, 2H, Ar-H), 7.33 (s, 2H, Ar-H), 11.66 ppm (s, 1H, NH).

(3) Synthesis of *N*-aryl-2-(formylphenoxy)-acetamides 5 and 6:

To a stirred suspension of *N*-aryl chloroacetamide derivatives **1** (0.002 mol) and 2-hydroxybenzaldehyde or 4-hydroxybenzaldehyde (0.002 mol, 0.24 g) in DMSO (15 mL) containing K_2CO_3 (0.002 mol, 0.27 g). The reaction components were stirred for 4 hours and then poured into 15 g crushed ice. The solid that formed in each case has been collected up by filtration and recrystallized from ethanol to obtain the targeted *N*-aryl-2-(formylphenoxy)-acetamides **5** and **6**.

2-(2-Formylphenoxy)-*N*-phenylacetamide (5a): IR (KBr): 3317 (NH), 1691, 1674 cm^{-1} (C=O).^{1}H NMR (DMSO-d_6): 4.89 (s, 2H, CH_2), 7.08 (t, *J* = 7.25 Hz, 1H, Ar-H), 7.13 (t, *J* = 7.75 Hz, 1H, Ar-H), 7.18 (d, *J* = 8.5 Hz, 1H, Ar-H), 7.33 (t, *J* = 7.75 Hz, 2H, Ar-H), 7.63 (d, *J* = 7.50 Hz, 2H, Ar-H), 7.65-7.67 (dd, *J* = 7.50, 1.50 Hz, 1H, Ar-H), 7.75-7.77 (dd, *J* = 7.50, 1.50 Hz, 1H, Ar-H), 10.15 (s, 1H, NH), 10.44 ppm (s, 1H, CHO).

2-(2-Formylphenoxy)-*N*-(*p*-tolyl)acetamide (5b): IR (KBr): 3309 (NH), broad centered at 1690 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 2.24 (s, 3H, CH_3), 4.86 (s, 2H, CH_2), 7.11-7.13 (m, 3H, Ar-H), 7.17 (d, *J* = 9.00 Hz, 1H, Ar-H), 7.51 (d, *J* = 8.50 Hz, 2H, Ar-H), 7.63-7.67 (m, 1H, Ar-H), 7.75-7.77 (dd, *J* = 2.50, 7.50 Hz, 1H, Ar-H), 10.06 (s, 1H, NH), 10.43 ppm (s, 1H, CHO).

***N*-(*p*-Anisyl)2-(2-formylphenoxy)-acetamide (5c):** IR (KBr): 3314 (NH), 1696, 1673 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 3.717 (s, 3H, OCH_3), 4.85 (s, 2H, CH_2), 6.90 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.13 (t, *J* = 7.50 Hz, 1H, Ar-H), 7.17 (d, *J* = 8.50 Hz 1H, Ar-H), 7.53 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.63-7.67 (m, 1H, Ar-H), 7.74-7.76 (dd, *J* = 2.00, 7.50 Hz, 1H, Ar-H), 10.01 (s, 1H, NH), 10.44 ppm (s, 1H, CHO).

2-(2-Formylphenoxy)-*N*-(4-nitrophenyl)acetamide (5d): IR (KBr): 3312 (NH), broad centered at 1689 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 4.90 (s, 2H, CH_2), 7.13 (t, *J* = 7.50 Hz, 1H, Ar-H), 7.17 (d, *J* = 8.50 Hz, 1H, Ar-H), 7.38 (d, *J* = 8.50 Hz, 2H, Ar-H), 7.65-7.68 (m, 3H, Ar-H), 7.74-7.76 (dd, *J* = 1.50, 7.50 Hz, 1H, Ar-H), 10.29 (s, 1H, NH), 10.44 ppm (s, 1H, CHO).

***N*-(4-Chlorophenyl)-2-(2-formylphenoxy)acetamide (5e):** IR (KBr): 3303 (NH), 1706, 1681 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 4.98 (s, 2H, CH_2), 7.13 (t, *J* = 7.20 Hz, 1H, Ar-H), 7.19 (d, *J* = 8.50 Hz, 1H, Ar-H), 7.63-7.67 (m, 1H, Ar-H), 7.75-7.76 (dd, *J* = 1.00, 7.50 Hz, 1H, Ar-H), 7.89 (d, *J* = 9.50 Hz, 2H, Ar-H), 8.24 (d, *J* = 9.00 Hz, 2H, Ar-H), 10.45 (s, 1H, CHO), 10.76 ppm (s, 1H, NH).

2-(4-Formylphenoxy)-*N*-phenylacetamide (6a): IR (KBr): 3371 (NH), 1702, 1680 cm^{-1} (C=O).

2-(4-Formylphenoxy)-*N*-(*p*-tolyl)acetamide (6b): IR (KBr): 3275 (NH), broad centered at 1673 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 2.24 (s, 3H, CH_3), 4.81 (s, 2H, CH_2), 7.11 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.17 (d, *J* = 8.50 Hz, 2H, Ar-H), 7.49 (d, *J* = 8.00 Hz, 2H, Ar-H), 7.88 (d, *J* = 9.00 Hz, 2H, Ar-H), 9.87 (s, 1H, CHO), 10.06 ppm (s, 1H, NH).

***N*-(*p*-Anisyl)-2-(4-formylphenoxy)-acetamide (6c):** IR (KBr): 3375 (NH), broad centered at 1682 cm^{-1} (C=O).

(4)Synthesisof2(4((2carbamothioylhydrazineylidene)methyl)-phenoxy)*N*(*p*tolyl)acetamide (7):

A mixture of 2-(4-formylphenoxy)-*N*-(*p*-tolyl)acetamide **(6b)** (0.002 mol, 0.53 g) and thiosemicarbazide (0.002 mol, 0.18 g) was dissolved in 20 mL ethyl alcohol and boiled using condenser for 4 hours. The precipitate that obtained on cooling was picked up by filtration and then recrystallized by from ethyl alcohol.

IR (KBr): 3420, 3360, 3148 (NH_2 and NH), 1667 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 2.24 (s, 3H, CH_3), 4.71 (s, 2H, CH_2), 7.01 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.11 (d, *J* = 8.50 Hz, 2H, Ar-H), 7.50 (d, *J* = 8.00 Hz, 2H, Ar-H), 7.75 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.91 (s, 1H), 8.11 (s, 1H) (NH_2), 7.98 (s, 1H, CH=N), 9.99 (s, 1H, NH), 11.32 ppm (s, 1H, NH).

(5) Synthesis of *N*-(4-chlorophenyl)-2-cyano-3(4(2oxo2(*p*tolylamino)ethoxy)phenyl)acrylamide (8):

2-(4-Formylphenoxy)-*N*-(*p*-tolyl)acetamide **(6b)** (0.002 mol, 0.53 g) was taken in a Round Bottom Flask containing ethanol (20 mL) and three drops piperidine. *N*-(4-Chlorophenyl)-2-cyanoacetamide (0.002 mol, 0.38 g) was added to the solution and refluxed for 4 hours. The solid that formed on cooling was filtered and recrystallization from EtOH.

IR (KBr): 3411, 3335 (N-H), 2213 (C≡N), broad centered at 1679 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 2.24 (s, 3H, CH_3), 4.82 (s, 2H, CH_2), 7.12 (d, *J* = 8.50 Hz, 2H, Ar-H), 7.42 (d, *J* = 9.00 Hz, 2H, Ar-H), 7.50 (d, *J* = 8.00 Hz, 2H, Ar-H), 7.69 (d, *J* = 9.00 Hz, 2H, Ar-H), 8.02 (d, *J* = 9.00 Hz, 2H, Ar-H), 8.20 (s, 1H, olefinic CH=C), 10.07 (s, 1H, NH), 10.41 ppm (s, 1H, NH).

(6)Synthesisof4acetyl3methyl5(phenylamino)thiophene-2-carboxamides 11 and 12:

2-Acetyl-3-oxo-*N*-phenylbutanethioamide **(9)** (0.002 mol, 0.47 g) was taken in sodium ethoxide solution (prepared by dissolving 0.05 g sodium granules in 15 dry ethanol). 2-Chloroacetamide (0.002 mol, 0.18 gm) and/or *N*-aryl 2-chloroacetamide derivatives **1** (0.002 mol) was added to the solution and refluxed for 30 minutes. The reaction solution was poured into 15 g crushed ice and neutralized with dilute HCl. The solid product that obtained by filtration was dried and purified by recrystallization form ethanol to furnish the conforming 4-acetylthiophene-2-carboxamides **11** and **12**.

4-Acetyl-3-methyl-5-(phenylamino)thiophene-2-carboxamide (11): IR (KBr): 3343, 3174 (NH_2 and NH), 1720, 1640 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): 2.51 (s, 3H, CH_3), 2.59 (s, 3H, CH_3), 7.14 (t, *J* = 7.25 Hz, 1H, Ar-H), 7.32 (s, 2H, NH_2), 7.35 (d, *J* = 7.50 Hz, 2H), 7.7.41 (d, *J* = 7.50 Hz, 2H), 11.45 ppm (s, 1H, NH).

4-Acetyl-3-methyl-5-(phenylamino)-*N*-(*p*-tolyl)thiophene-2-carboxamide (12a): IR (KBr): 3271 (NH), 1636 cm^{-1} (C=O). ^{1}H NMR ($CDCl_3$): 2.32 (s, 3H, CH_3), 2.59 (s, 3H, CH_3), 2.77 (s, 3H, CH_3), 7.14-7.43 (m, 10H, Ar-H and NH), 11.97 ppm (s, 1H, NH).

4-Acetyl-*N*-(*p*-anisyl)-3-methyl-5-(phenylamino)thiophene-2-carboxamide (12b): IR (KBr): 3268 (NH), broad centered at 1606 cm^{-1} (C=O). ^{1}H NMR (DMSO-d_6): δ/ppm= 2.53 (s, 3H, CH_3), 2.60 (s, 3H, CH_3), 3.72 (s, 3H, OCH_3), 6.88 (d, *J* = 8.50 Hz, 2H, Ar-H), 7.16 (t, *J* = 7.20 Hz, 1H, Ar-H), 7.38 (m, 2H, Ar-H), 7.44 (t, *J* = 8.10 Hz, 2H, Ar-H), 7.51 (d, *J* = 9.00 Hz, 2H, Ar-H), 9.78 (s, 1H, NH), 11.45 ppm (s, 1H, NH).

(7) Synthesis of 3-(5-oxo-3-phenylthiazolidin-2-ylidene)pentane-2,4-dione (13):

To a suspension of 2-acetyl-3-oxo-*N*-phenylbutanethioamide **(9)** (0.002 mol, 0.47 gm) and *N*-aryl 2-chloroacetamides **1** (0.002 mol, 0.18 gm) in 15 mL dry ethanol, 0.5 mL triethylamine was added. The reaction components were boiled using condenser for 2 hours. The solid that separated by filtration was dried to afford thiazolidine-5-one derivative **13**.

IR (KBr): 1642, 1719 cm^{-1} (C=O). ^{1}H NMR ($CDCl_3$): 2.07 (s, 6H, 2 CH_3), 3.83 (s, 2H, CH_2), 7.21-7.58 ppm (m, 5H, Ar-H).

Table (1): Physicochemical data for the synthesized sulfides **2a-e** and thiazolidine-4-ones **4a-e**.

Cpd. No.	Molecular formula	MW	M.P., ºC Lit. M.P.	Yield, %	Analysis %, Calcd. (Found)		
					C	H	N
2a	$C_{12}H_{15}NO_3S$	253	Oil	82	----	----	----
2b	$C_{13}H_{17}NO_3S$	267	58-59	70	58.41(58.55)	6.41(6.39)	5.24(5.15)
2c	$C_{13}H_{17}NO_4S$	283	62-63	75	55.11(55.05)	6.05(6.08)	4.94(4.88)
2d	$C_{12}H_{14}N_2O_5S$	298	92-93	82	48.32(48.44)	4.73(4.77)	9.39(9.30)
2e	$C_{12}H_{14}NClO_3$	287	69-70	78	50.09(50.17)	4.90(4.93)	4.87(4.80)
4a	$C_9H_8N_2OS$	192	154-155150-152 [17]	57	56.23(56.08)	4.19(4.26	14.57(14.64
4b	$C_{10}H_{10}N_2OS$	206	185-186180-183 [17]	74	58.23(58.12)	4.89(4.93)	13.58(13.50)
4c	$C_{10}H_{10}N_2O_2S$	222	186-187188–191 [17]	78	54.04(54.15)	4.54(4.60)	12.60(12.66)
4d	$C_9H_7N_3O_3S$	237	245-247	82	45.57(45.48)	2.97(2.99)	17.71(17.82)
4e	$C_9H_7ClN_2OS$	226	210-212202–205 [17]	66	47.69(47.78)	3.11(3.04)	12.36(12.29)

Table (2): Physicochemical data for the synthesized phenoxyacetamides **5-8** and 4-acetylthiophenes **11-12**.

Cpd. No.	Molecular formula	MW	MP, ºC	Yield, %		Analysis %, Calcd. (Found)	
					C	H	N
5a	$C_{15}H_{13}NO_3$	255	108-110	55	70.58(70.42)	5.13(5.20)	5.49(5.57)
5b	$C_{16}H_{15}NO_3$	269	118-120	61.5	71.36(71.25)	5.61(5.66)	5.20(5.14)
5c	$C_{16}H_{15}NO_4$	285	104-106	56.5	67.36(67.47)	5.30(5.34)	4.91(4.84)
5d	$C_{15}H_{12}N_2O_5$	300	128-130	73.5	60.00(60.09)	4.03(4.05)	9.33(9.23)
5e	$C_{15}H_{12}ClNO_3$	289	206-208	58.5	62.19(62.03)	4.18(4.10)	4.83(4.95)
6a	$C_{15}H_{13}NO_3$	255	128-130	52	70.58(70.47)	5.13(5.15)	5.49(5.60)
6b	$C_{16}H_{15}NO_3$	269	118-120	60	71.36(71.40)	5.61(5.60)	5.20(5.16)
6c	$C_{16}H_{15}NO_4$	285	144-146	71	67.36(67.24)	5.30(5.35)	4.91(4.97)
7	$C_{17}H_{18}N_4O_2S$	342	264-266	83	59.63(59.79)	5.30(5.25)	16.36(16.48
8	$C_{25}H_{20}ClN_3O_3$	445	254-256	62	67.34(67.21)	4.52(4.44)	9.42(9.52)
11	$C_{14}H_{14}N_2O_2S$	274	218-220	48.5	61.29(61.40)	5.14(5.11)	10.21(10.30)
12a	$C_{21}H_{20}N_2O_2S$	364	224-226	38	69.21(69.06)	5.53(5.49)	7.69(7.62)
12b	$C_{21}H_{20}N_2O_3S$	380	200-202	48	66.30(66.22)	5.30(5.41)	7.36(7.25)
13	$C_{14}H_{13}NO_3S$	275	174-176	65	61.08(61.16)	4.76(4.78)	5.09(5.15)

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