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Synthesis, Characterization and Antimicrobial Activities of Some Novel Thiazoles and Thiazolo-[3,2-*b*]-[1,2,4]-triazole Derivatives

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ABSTRACT

*The reaction of 2-(aryloxymethyl) benzo thioamide with various substituted phenacyl bromides afforded 2-[2-(aryloxymethyl)-phenyl]-N'-[4-(aryl)-thiazol-2yl]-benzohydrazide derivatives. The benzothiamide is prepared from corresponding hydrazide in KSCN/HCl in methanol. Substituted thiazolo-[3,2-b]-[1,2,4]-triazole derivatives were synthesized by a condensation reaction of the one pot three component reaction of substituted aromatic aldehydes and monochloroacetic acid in acetic acid in the presence of acetic anhydride and anhydrous sodium acetate with 5-{2-[(aryloxymethyl)-methyl]-phenyl}-4H-[1,2,4]-triazole-3-thiol. All structures of the newly synthesized compounds were elucidated by elemental analysis and spectral data. The new compounds have been tested for their in vitro antimicrobial activities. However, they shown moderate to good antimicrobial activity. Among the tested compounds **3h,** and **5d** shown significant antibacterial activity while **3d, 3h** and **5d** shown significant antifungal activity.*

Keywords: Multi component reaction, [1,2,4]-Triazole-5-thione, Antimicrobial activity, 2-(aryloxy methyl) phenyl moiety.

INTRODUCTION

Antimicrobial activity of thiazole derivatives has been extensively studied by many researchers [1-3]. Compounds containing thiazole ring system are used as antiviral agents and some are used as pesticides [4, 5]. Antitumor and cytotoxic activities of thiazole derivatives are well known in the literature [6-8]. Thiazoles are important class of heterocyclic compounds, found in many potent biologically active molecules such as Fentiazac, Meloxicam [9-11], (anti-inflammatory agent), Nizatidine [12] (antiulcer agent) and Sulfatiazol (antimicrobial agent). Differently substituted thiazoles are important biological agents and a significant amount of research activity has been directed towards this class. In particular, they are used as anti-inflammatory, antimicrobial [13, 14], antitumor [15], anticonvulsant [16], analgesic [17], and anticancer agents [18]. Heterocyclic compounds containing 1,2,4-triazole moiety represent important pharmacophores and play a vital role as medicinal agents. A degree of respectability has been bestowed for 1,2,4-triazole derivatives due to their wide range of biological activities such as antimicrobial, anti-

inflammatory [19] and anticancer [20]. Certain 1,2,4-triazoles also find applications in the preparation of photographic plates, polymers and as analytical agents [21].

Multi-component reactions (MCRs) are fundamentally different from two component reactions in several aspects. The convergent synthetic pathways of MCRs show advantages over linear or divergent approaches with respect to speed, time, yield and reproducibility. Among organic reactions, multi-component reactions are highly convergent [22]. They constitute a superior tool for diversity-oriented and complexity-oriented and complexity-generating synthesis for drug discovery [23]. MCRs being one pot reactions, they practically single step conversions and are easier to carry out than multistep synthesis.

In continuation of our research work to explore potent bioactive thiazole containing molecules [24, 25], 2-[2-(substituted phenoxy methyl) phenyl]-N′[4-(aryl)-[1,3]-thiazol 2yl]-benzo hydrazide derivatives and substituted thiazolo-[3,2-*b*]-[1,2,4]-triazole derivatives were prepared and characterized by analytical and spectral methods. All the compounds were screened for their antifungal and antibacterial activities.

MATERIALS AND METHODS

Melting points were taken in an open capillary tubes and are uncorrected. The IR spectra were recorded on a Shimadzu-FTIR Infrared Spectrometer in KBr pellets (γ_{max} in cm^{-1}). The ^1H NMR spectra were recorded ($CDCl_3$/DMSO-d_6 mixture) on a BRUKER AVANCE II -400 (400 MHz) spectrometer using TMS as an internal standard (chemical. shift in δ ppm). Spin multiplets are given as s (singlet), d (doublet), t (triplet) and m (multiplet). Mass spectra were recorded in Finnigan MAT8230 mass spectrometer. Elemental analysis (CHNS) was performed on the CHNS Elementar Vario EL III. The purity of the compounds was confirmed by thin layer chromatography (TLC) using Merck silica gel 60 F_{254} coated alumina plates. The progress of the reaction was also monitored by TLC.

Compound 2-(aryloxymethyl)-benzoylhydrazide (**1a-d**) were prepared from 2-(aryloxymethyl) benzoic acid ethyl ester by treating with hydrazine hydrate in methanol [24].

Sythesis of 2-(aryloxymethyl)-benzo thioamide (2): 2-(aryloxymethyl)-benzoylhydrazide **2** (0.1 mol) was dissolved in water (100 mL) containing concentrated hydrochloric acid (10 mL). Potassium thiocyanate (0.2 mol) was added to it and the mixture was warmed on a water bath for 5 h. The reaction mixture was cooled and precipitated solid was filtered, dried and recrystalized from ethanol to get aroyl thiosemicarbazide.

2-{2-[(2-methylphenoxy)methyl]benzoyl}hydrazinecarbothioamide (2a): Colorless crystals in 82% yield; m.p. 140-142^{0}C. IR (cm^{-1}) 3442 (NH, NH_2), 3260 (NH_2), 2980 (C-H), 1692 (CO-NH). ^1H NMR (400 MHz, $CDCl_3$) δ = 2.23 (s, 3H, Ar-CH_3), 5.30 (s, 2H, OCH_2), 6.83 (br.s, 2H, NH_2), 6.95-6.99 (m, 2H, Ring A-H), 7.22-7.26 (m, 2H, Ring A-H), 7.43-7.72 (m, 4H, Ring B-H), 10.15(s,1H,NH), 10.89(s,1H,NH). *Anal.*Calculated for $C_{16}H_{17}N_3O_2S$: C, 60.93, H, 5.43, N, 13.32; found: C, 60.82; H, 5.40; N, 13.30. MS(EI). *m/z* 315 (100%, M^+).

2-{2-[(3-methylphenoxy)methyl]benzoyl}hydrazinecarbothioamide (2b): Colorless crystals in 84% yield. m.p. 178-180^{0}C. IR (cm^{-1}) 3448 (NH, NH_2), 3266 (NH_2), 2985 (C-H), 1690 (CO-NH).

2-{2-[(4-methylphenoxy)methyl]benzoyl}hydrazinecarbothioamide (2c): Colorless crystals in 80% yield. m.p. 190-192^{0}C. IR (cm^{-1}) 3452 (NH, NH_2), 3264 (NH_2), 2980 (C-H), 1693 (CO-NH).

2-{2-[(4-chlorophenoxy)methyl]benzoyl}hydrazinecarbothioamide (2d): Colorless crystals in 82% yield. m.p. 172-174^{0}C. IR (cm^{-1}) 3445 (NH, NH_2), 3265 (NH_2), 2980 (C-H), 1698 (CO-NH), 748 (C-Cl). ^1H NMR (400 MHz, $CDCl_3$) δ = 5.36 (s, 2H, OCH_2), 6.88 (br.s, 2H, NH_2), 6.67 (d, 2H, Ring A-H, *J* = 8.9

Hz), 7.16 (d, 2H, Ring A-H, *J* = 8.9 Hz), 7.33-7.62 (m, 2H, Ring B-H), 7.68-7.76 (d, 1H, Ring B-H, *J* = 7.8 Hz), 7.88-7.96 (d, 1H, Ring B-H, *J* = 7.8 Hz), 10.18(s,1H, NH), 10.93 (s, 1H, NH). MS (EI). *m/z* 335 (100%, M^+).

Sythesis of 2-(aryloxymethyl)-N′-[4-(aryl)-[1,3]-thiazol-2yl] benzohydrazide derivatives (3): An equimolar mixture of the appropriate benzothioamide **2** (0.01 mol) and phenacylbromide (0.01 mol) in methanol was refluxed for 4 h. After completion of the reaction, the mixture was cooled to room temperature and the solid obtained was filtered. The crude product was recrystallized from ethanol.

N′-[4-(4-Hydroxy-3-carboxamidophenyl)-2-(2-methylphenoxymethyl)-[1,3]-thiazol-2-yl]benzo hydrazide (3a): IR (KBr, $\gamma_{max,}$ cm^{-1}): 3488 (O-H), 3107 (NH_2), 3017 (ArC-H), 2981 (C-H), 1712 (C=O), 1596 (C=N), 1189 (C-O); ^{1}H NMR (400 MHz, DMSO, δ ppm): 2.49 (s, 3H, Ring A-CH_3), 5.06 (s, 2H, OCH_2), 6.80 (d, 2H, Ring A-H, *J*=8.3 Hz), 6.85 (d, 2H, Ring A-H, *J*=8.3 Hz), 7.87 (t, 1H, Ring B-H), 7.92 (s, 1H, thiazolyl-H), 7.94 (s, 1H, Ring C-H), 8.21 (br.s., 2H, NH_2), 8.26 (t, 1H, Ring B-H), 8.47 (d, 2H, Ring C-H, *J* = 7.6 Hz), 8.83 (d, 2H, Ring B-H, *J* = 7.8 Hz), 10.15 (s, 1 H, NH), 10.89 (s, 1 H, NH), 13.86 (s, 1 H, OH); LC MS: m/z 474 (M^+, 100%).

N′-[4-(4-Hydroxy-3-carboxamidophenyl)-2-(3-methylphenoxymethyl)-[1,3]-thiazol-2-yl]benzo hydrazide (3b): IR (KBr, $\gamma_{max,}$ cm^{-1}): 3461 (O-H), 3207 (NH_2), 3013 (ArC-H), 2922 (C-H), 1706 (C=O), 1602 (C=N), 1110 (C-O); LCMS: m/z 474 (M^+, 100%).

N′-[4-(4-Hydroxy-3-carboxamidophenyl)-2-(4-methylphenoxymethyl)-[1,3]-thiazol-2-yl]benzo hydrazide (3c): IR (KBr, $\gamma_{max,}$ cm^{-1}): 3445 (O-H), 3207 (NH_2), 3011 (ArC-H), 2921 (C-H), 1712 (C=O), 1608 (C=N), 1115 (C-O); ^{1}H NMR (300 MHz, $CDCl_3$, δ ppm): 2.86 (s, 3H, Ring A-CH_3), 5.56 (s, 2H, OCH_2), 6.76 (d, 2H, Ring A-H, *J* = 8.4 Hz), 6.88 (d, 2H, Ring A-H, *J* = 8.4 Hz), 7.40 (t, 1H, Ring B-H), 7.85 (s, 1H, thiazolyl-H), 7.89 (s, 1H, Ring C-H), 8.21 (br.s, 2H, -NH_2), 8.25 (t, 1H, Ring B-H), 8.28 (d, 2H, Ring C-H, *J* = 7.9 Hz), 8.32-8.34 (m, 2H, Ring B-H), 10.18 (s, 1 H, NH), 10.92 (s, 1 H, NH), 12.67 (s, 1H, OH).

2-(4-Chlorophenoxymethyl)-N′-[4-(4-hydroxy-3-carboxamidophenyl)-[1,3]-thiazol-2-yl]benzo hydrazide (3d): IR (KBr, $\gamma_{max,}$ cm^{-1}): 3465 (O-H), 3328, 3128 (NH_2), 3016 (ArC-H), 2920 (C-H), 1606 (C=N), 1102 (C-O), 784 (C-Cl); ^{1}H NMR (400 MHz, $CDCl_3$, δ ppm): 5.45 (s, 2H, OCH_2), 6.86 (d, 2H, Ring A-H, *J* = 8.8 Hz), 7.20 (d, 2H, Ring A-H, *J* = 8.8 Hz), 7.31 (t, 1H, Ring B-H), 7.46 (t, 1H, Ring B-H), 7.72 (br.s, 2H, -NH_2), 7.83 (s, 1H, Ring C-H), 7.89 (s, 1H, thiazolyl-H), 7.99 (d, 1H, Ring B-H, *J*= 8.4 Hz), 8.18 (d, 1H, Ring B-H, *J*= 8.4 Hz), 8.42 (d, 2H, Ring C-H, *J*= 7.8 Hz), 10.22 (s, 1 H, NH), 10.91 (s, 1 H, NH), 12.58 (s, 1 H, OH); LC MS: m/z 496 (M^+, 100%), 498 (M+2, 33%).

N′-[4-(5-Chloro-2-sulfonamido-thien-3-yl)-2-(3-methylphenoxymethyl)-[1,3]-thiazol-2-yl]benzo hydrazide (3f): IR (KBr, $\gamma_{max,}$ cm^{-1}) : 3378, 3131 (NH_2), 3024 (ArC-H), 2890 (C-H), 1602 (C=N), 1108 (C-O), 1070 (C-S), 776 (C-Cl); ^{1}H NMR (400 MHz, $CDCl_3$, δ ppm): 2.17 (s, 3H, Ring A-CH_3), 5.25 (s, 2H, OCH_2), 6.31 (s, 2H, -SO_2NH_2), 6.86-6.95 (m, 4H, Ring A-H), 7.10-7.16 (m, 2H, Ring B-H), 7.22 (s, 1H, thienyl-H), 7.27 (s, 1H, thiozolyl-H), 7.48-7.63 (m, 2H, Ring B-H), 10.16 (s, 1 H, NH), 10.94 (s, 1 H, NH) ; LC MS: m/z 536 (M^+, 100%), 438 (M+2, 34%).

N′-[4-(5-Chloro-2-sulfonamido-thien-3-yl)-2-(4-methylphenoxymethyl)-[1,3]-thiazol-2-yl]benzo hydrazide (3g): IR (KBr, $\gamma_{max,}$ cm^{-1}) : 3394, 3125 (NH_2), 3027 (ArC-H), 2889 (C-H), 1604 (C=N), 1105 (C-O), 1065 (C-S), 766 (C-Cl); ^{1}H NMR (300 MHz, $CDCl_3$, δ ppm): 2.23 (s, 3H, Ring A-CH_3), 5.33 (s, 2H, OCH_2), 6.37 (s, 2H, -SO_2NH_2), 6.73 (d, 2H, Ring A-H, *J*= 8.2 Hz), 6.80 (d, 2H, Ring A-H, *J*= 8.2 Hz), 7.02 (s, 1H, thienyl-H), 7.12 (s, 1H, thiozolyl-H), 7.23-7.36 (m, 2H, Ring B-H), 7.38-7.52 (m, 2H, Ring B-H), 10.12 (s, 1 H, NH), 10.81 (s, 1 H, NH).

2-(4-Chlorophenoxymethyl)-N′-[4-(5-Chloro-2-sulfonamido-thien-3-yl)-[1,3]-thiazol-2-yl]benzo hydrazide (3h): IR (KBr, $\gamma_{max,}$ cm^{-1}) : 3387, 3120 (NH_2), 3030 (ArC-H), 2885 (C-H), 1601(C=N), 1108 (C-O), 1066 (C-S), 774 (C-Cl); ^{1}H NMR (300 MHz, $CDCl_3$, δ ppm): 5.62 (s, 2H, OCH_2), 6.32 (s, 2H, -SO_2NH_2), 6.60 (d, 2H, Ring A-H, *J* = 8.8 Hz), 6.68 (d, 2H, Ring A-H, *J* = 8.8 Hz), 6.74 (s, 1H, thienyl-H), 7.06 (s, 1H, thiozolyl-H), 7.12-7.27 (m, 2H, Ring B-H), 7.32-7.44 (m, 2H, Ring B-H), 10.16 (s, 1 H, NH), 10.94 (s, 1 H, NH); LCMS: m/z 556 (M^+, 100%).

2-(2-Methylphenoxymethyl)-N′-[4-(4-nitrophenyl)-[1,3]-thiazol-2-yl]benzohydrazide (3i): IR (KBr, $\gamma_{max,}$ cm^{-1}) : 3084 (ArC-H), 2880 (C-H), 1605 (C=N), 1450 (NO_2), 1243 (NO_2), 1148 (C-O), 1062 (C-S); ^{1}H NMR (400 MHz, $CDCl_3$, δ ppm): 2.32 (s, 3H, Ring A-CH_3), 5.55 (s, 2H, OCH_2), 6.78-6.84 (m, 3H, Ring A-H), 7.18-7.26 (m, 1H, Ring A-H), 7.48 (t, 2H, Ring B-H, *J* = 8.1 Hz), 7.73 (d, 1H, Ring B-H, *J* = 8.8 Hz), 7.78 (d, 1H, Ring B-H, *J* = 8.8 Hz), 7.85 (s, 1H, thiazolyl-H), 8.02 (d, 2H, Ring C-H, *J* = 8.6 Hz), 8.24 (d, 2H, Ring C-H, *J* = 8.5 Hz), 10.12 (s, 1 H, NH), 10.84 (s, 1 H, NH); LCMS: m/z 460 (M^+, 100%).

2-(3-Methylphenoxymethyl)-N′-[4-(4-nitrophenyl)-[1,3]-thiazol-2-yl]benzohydrazide (3j): IR (KBr, $\gamma_{max,}$ cm^{-1}) : 3092 (ArC-H), 2876 (C-H), 1608 (C=N), 1455 (NO_2), 1242 (NO_2), 1096 (C-O), 1067 (C-S); ^{1}H NMR (400 MHz, $CDCl_3$, δ ppm): 2.46 (s, 3H, Ring A-CH_3), 5.57 (s, 2H, OCH_2), 6.78-6.84 (m, 2H, Ring A-H), 7.18-7.26 (m, 2H, Ring A-H), 7.46-7.52 (m, 2H, Ring B-H), 7.50-7.52 (m, 2H, Ring B-H), 7.74 (s, 1H, thiazolyl-H), 8.02 (d, 2H, Ring C-H, *J* = 8.2 Hz), 8.26 (d, 2H, Ring C-H, *J* = 8.2 Hz), 10.24 (s, 1 H, NH), 11.06 (s, 1 H, NH).

2-(4-Chlorophenoxymethyl)-N′-[4-(4-nitrophenyl)-[1,3]-thiazol-2-yl]benzohydrazide (3l): IR (KBr, $\gamma_{max,}$ cm^{-1}) : 3088 (ArC-H), 2874 (C-H), 1600 (C=N), 1450 (NO_2), 1234 (NO_2), 1084 (C-O), 1064 (C-S), 778 (C-Cl); ^{1}H NMR (400 MHz, $CDCl_3$, δ ppm): 5.46 (s, 2H, OCH_2), 6.64 (d, 2H, Ring A-H, *J* = 8.8 Hz), 6.76 (d, 2H, Ring A-H, *J* = 8.8 Hz), 7.26-7.32 (m, 2H, Ring B-H), 7.40-7.56 (m, 2H, Ring B-H), 7.88 (s, 1H, thiazolyl-H), 8.14 (d, 2H, Ring C-H, *J* = 8.2 Hz), 8.35 (d, 2H, Ring C-H, *J* = 8.2 Hz), 10.12 (s, 1 H, NH), 10.94 (s, 1 H, NH); LCMS: m/z 482 (M^+, 100%).

5-Substituted-4H-1,2,4-trizole-3-thiol (4): A mixture of aroyl thiosemicarbazide (0.01 mol) and potassium hydroxide (5%, 100 mL) was refluxed on a water bath for 3 h. The reaction mixture was poured into crushed ice and acidified with dilute hydrochloric acid. The precipitate thus obtained was filtered, dried and recrystallised from ethanol.

2,4-Dihydro-5-{2-[(2-methylphenoxy)methyl]phenyl}-3H-[1,2,4]-triazole-3-thione (4a): Colourless microcrystals in 80% yield; m.p.: 120-122 °C; IR (KBr, $\gamma_{max,}$ cm^{-1}): 3372 (NH), 3092 (ArC-H), 2976 (C-H), 1602 (C=N), 1228 (C=S), 1154 (C-O); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 2.17 (s, 3H, Ring A-CH_3), 5.35 (s, 2H, OCH_2), 6.80 (t, 1H, Ring A-H, *J* = 8.2 Hz), 7.04 (d, 1H, Ring A-H, *J* = 8.8 Hz), 7.26-7.32 (m, 2H, Ring A-H), 7.54 (t, 1H, Ring B-H), 7.65 (t, 1H, Ring B-H), 7.88 (d, 2H, Ring B-H, *J* = 8.8 Hz), 12.04 (s, 1H, NH), 12.10 (s, 1H, NH); Anal. Calcd. (%) for $C_{16}H_{15}N_3OS$: C, 64.62; H, 5.08; N, 14.13; S,10.76. Found: C, 64.60; H, 5.05; N, 14.10; S, 10.72.

2,4-Dihydro-5-{2-[(3-methylphenoxy)methyl]phenyl}-3H-[1,2,4]-triazole-3-thione (4b): Colourless microcrystals in 80% yield; m.p.: 128-130 °C; IR (KBr, $\gamma_{max,}$ cm^{-1}): 3364 (NH), 3056 (ArC-H), 2973 (C-H), 1624 (C=N), 1254 (C=S), 1150 (C-O); Anal. Calcd. (%) for $C_{16}H_{15}N_3OS$: C, 64.62; H, 5.08; N, 14.13; S,10.76. Found: C, 64.65; H, 5.02; N, 14.16; S, 10.70.

2,4-Dihydro-5-{2-[(4-methylphenoxy)methyl]phenyl}-3H-[1,2,4]-triazole-3-thione (4c): Colourless microcrystals in 80% yield; m.p.: 126-129 °C; IR (KBr, γ_{max} cm^{-1}): 3371 (NH), 3071 (ArC-H), 2973 (C-H), 1624 (C=N), 1258 (C=S), 1152 (C-O); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 2.17 (s, 3H, Ring A-CH_3), 5.35 (s, 2H, OCH_2), 6.80 (d, 1H, Ring A-H, *J* = 8.3 Hz), 7.04 (d, 1H, Ring A-H, *J* = 8.3 Hz), 7.38

(t, 1H, Ring B-H), 7.53 (t, 1H, Ring B-H), 7.58 (d, 1H, Ring B-H, *J* = 7.5 Hz), 7.87 (d, 1H, Ring B-H, *J* = 7.7 Hz), 12.00 (s, 1H, NH), 12.06 (s, 1H, NH); Anal. Calcd. (%) for $C_{16}H_{15}N_3OS$: C, 64.62; H, 5.08; N, 14.13; S,10.76. Found: C, 64.60; H, 5.08; N, 14.14; S, 10.78.

5-{2-[(4-Chlorophenoxy)methyl]phenyl}-2,4-dihydro-3H-[1,2,4]-triazole-3-thione (4d): Colourless microcrystals in 80% yield; m.p.: 133-134 °C; IR (KBr, γ_{max} cm^{-1}) : 3364 (NH), 3072 (ArC-H), 2976 (C-H), 1622 (C=N), 1242 (C=S); Anal. Calcd. (%) for $C_{15}H_{12}ClN_3OS$: C, 56.69; H, 3.81; N, 13.22; S,10.06. Found: C, 56.63; H, 3.82; N, 13.20; S, 10.04.

Procedure for the preparation of 2-(aryloxymethyl)-methyl]-phenyl)-ethyl-5-[aryl methylidene]-thiazolo-[3,2-b][1,2,4]-trizol-6[5H]-one (5): A mixture of mercapto triazole **4** (0.01 mol), monochloroacetic acid (0.015 mol), anhydrous sodium acetate (2 g), glacial acetic acid (20 mL), acetic anhydride (15 mL) and substituted benzaldehyde (0.01 mol) was heated to reflux for 6-8 h. The reaction mixture was cooled and poured into crushed ice with vigorous stirring. The solid obtained was filtered, washed, with water, dried and recrystallised from a mixture ethanol and dimethyl formamide.

2-(2-Methylphenoxy)methyl]phenyl)-5-[3,4,5-trichlorophenylmethylidene]-[1,3]-thiazolo-[3,2-b]-[1,2,4]-triazol-6[5H]-one (5a*):* IR (KBr, γ_{max} in cm^{-1}): 3023 (Ar-H), 2914 (C-H), 1744 (C=O), 1594 (C=N), 1240 (C-O), 735 (C-Cl); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 2.20 (s, 3H, Ring A-CH_3), 5.54 (s, 2H, OCH_2), 6.82-6.91 (m, 2H, Ring A-H), 7.11-7.20 (m, 2H, Ring A-H), 7.52 (t, 1H, Ring B-H), 7.62 (t, 1H, Ring B-H), 7.67 (d, 1H, Ring C-H, *J* = 7.2 Hz), 7.77 (d, 1H, Ring B-H, *J* = 7.7 Hz), 8.11 (d, 1H, Ring B-H, *J* = 7.5 Hz), 8.13 (d, 1H, Ring C-H, *J* = 2.2 Hz), 8.22 (s, 1H, thiazolidinone-H); LCMS: m/z 529 (M^+, 100%).

2-(3-Methylphenoxy)methyl]phenyl)-5-[3,4,5-trichlorophenylmethylidene]-[1,3]-thiazolo-[3,2-b]-[1,2,4]-triazol-6[5H]-one (5b): IR (KBr, γ_{max} in cm^{-1}): 3022 (Ar-H), 2964 (C-H), 1730 (C=O), 1622 (C=N), 1228 (C-O), 744 (C-Cl).

2-(4-Methylphenoxy)methyl]phenyl)-5-[3,4,5-trichlorophenylmethylidene]-[1,3]-thiazolo-[3,2-b]-[1,2,4]-triazol-6[5H]-one (5c): IR (KBr, γ_{max} in cm^{-1}): 3036 (Ar-H), 2953 (C-H), 1730 (C=O), 1610 (C=N), 1206 (C-O), 726 (C-Cl); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 2.26 (s, 3H, Ring A-CH_3), 5.56 (s, 2H, OCH_2), 6.80 (d, 2H, Ring A-H, *J*= 7.8 Hz), 7.11 (d, 2H, Ring A-H, *J*=7.8 Hz), 7.44 (t, 1H, Ring B-H), 7.53 (t, 1H, Ring B-H), 7.64 (d, 1H, Ring B-H, *J*=7.6 Hz), 7.67 (d, 1H, Ring C-H, *J*=2.2 Hz), 8.11 (d, 1H, Ring B-H, *J*=7.6 Hz), 8.17 (d, 1H, Ring C-H, *J*=2.2 Hz), 8.18 (s, 1H, thiazolidinone-H).

2-(4-Chlorophenoxy)methyl]phenyl)-5-[3,4,5-trichlorophenylmethylidene]-[1,3]-thiazolo-[3,2-b]-[1,2,4]-triazol-6[5H]-one (5d): IR (KBr, γ_{max} in cm^{-1}): 3033 (Ar-H), 2950 (C-H), 1718 (C=O), 1618 (C=N), 740 (C-Cl); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 5.46 (s, 2H, OCH_2), 6.82 (d, 2H, Ring A-H, *J*=8.3 Hz), 7.04 (d, 2H, Ring A-H, *J*=8.4 Hz), 7.30 (t, 1H, Ring B-H), 7.38 (t, 1H, Ring B-H), 7.47 (d, 1H, Ring B-H, *J*=7.8 Hz), 7.90 (d, 1H, Ring C-H, *J*=2.3 Hz), 8.04 (d, 1H, Ring B-H, *J*=7.6 Hz), 8.06 (d, 1H, Ring B-H, *J*=7.6 Hz), 8.10 (s, 1H, thiazolidinone-H).

5-[(6-Methoxy-2-naphthyl)methylidene]-2-(2-methylphenoxy)methyl]phenyl)-[1,3]-thiazolo [3,2-b]-[1,2,4]-triazol-6[5H]-one (5e): IR (KBr, γ_{max} in cm^{-1}): 3028 (Ar-H), 2955 (C-H), 1736 (C=O), 1612 (C=N), 1190 (C-O); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 2.18 (s, 3H, Ring A-CH_3), 3.40 (s, 3H, OCH_3), 5.27 (s, 2H, OCH_2), 6.80-7.10 (m, 4H, Ring A-H), 7.44-7.49 (m, 4H, Ring B-H/ Ring C-H), 7.55-7.89 (m, 6H, Ring B-H/ Ring C-H), 8.33 (s, 1H, thiazolidinone-H); LCMS: m/z 505 (M^+, 100%).

5-[(6-Methoxy-2-naphthyl)methylidene]-2-(3-methylphenoxy)methyl]phenyl)-[1,3]-thiazolo [3,2-b]-[1,2,4]-triazol-6[5H]-one (5f): IR (KBr, γ_{max} in cm^{-1}): 3020 (Ar-H), 2962 (C-H), 1728 (C=O), 1618 (C=N), 1205 (C-O).

5-[(6-Methoxy-2-naphthyl)methylidene]-2-(4-methylphenoxy)methyl]phenyl)-[1,3]-thiazolo [3,2-b]-[1,2,4]-triazol-6[5H]-one (5g): IR (KBr, γ_{max} in cm^{-1}): 3028 (Ar-H), 2955 (C-H), 1736 (C=O), 1612 (C=N), 1210 (C-O); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 2.48 (s, 3H, Ring A-CH_3), 3.53 (s, 3H, OCH_3), 5.32 (s, 2H, OCH_2), 6.74 (d, 2H, Ring A-H, *J*=7.9 Hz), 7.02 (d, 2H, Ring A-H, *J*=7.9 Hz), 7.24-7.38 (m, 4H, Ring B-H/ Ring C-H), 7.42-7.78 (m, 6H, Ring B-H/Ring C-H), 8.15 (s, 1H, thiazolidinone-H). LCMS: m/z 505 (M^+, 100%).

2-(4-Chlorophenoxy)methyl]phenyl)-5-[(6-methoxy-2-naphthyl)methylidene]-[1,3]-thiazolo [3,2-b]-[1,2,4]-triazol-6[5H]-one (5h): IR (KBr, γ_{max} in cm^{-1}): 3028 (Ar-H), 2955 (C-H), 1736 (C=O), 1612 (C=N), 1208 (C-O), 739 (C-Cl); ^{1}H NMR (400 MHz, DMSO-d_6, δ ppm): 3.27 (s, 3H, OCH_3), 5.56 (s, 2H, OCH_2), 6.84 (d, 2H, Ring A-H, *J*=8.0 Hz), 6.98 (d, 2H, Ring A-H, *J*=8.0 Hz), 7.06-7.23 (m, 4H, Ring B-H/ Ring C-H), 7.34-7.64 (m, 6H, Ring B-H/Ring C-H), 7.96 (s, 1H, thiazolidinone-H); LCMS: m/z 526 (M^+, 100%).

Antibacterial activity: The newly synthesized compounds were screened for their antibacterial activity against *Staphylococcus aureus* (ATTC-25923), *Escherichia coli* (ATTC-25922), *Pseudomonas aeruginosa* (ATTC-27853) and *Klebsiella pneumoniae* (recultured) bacterial stains by serial plate dilution method [26, 27]. Serial dilutions of the drug in Muller Hinton broth were taken in tubes and their pH was adjusted to 5.0 using phosphate buffer. A standardized suspension of the test bacterium was inoculated and incubated for 16-18 h at 37^{o}C. The minimum inhibitory concentration (MIC) was noted by seeing the lowest concentration of the drug at which there was no visible growth.

A number of antibacterial discs were placed on the agar for the sole purpose of producing zones of inhibition in the bacterial lawn. Twenty milliliters of agar media was poured into each Petri dish. Excess of suspension was decanted and plates were dried by placing in an incubator at 37^{o}C for an hour. Using a punch wells were made on these seeds agar plates and minimum inhibitory concentrations of the test compounds in dimethyl sulfoxide (DMSO) were added into each labeled well. A control was also prepared for the plates in the same way using DMSO as a solvent. The Petri dishes were prepared in triplicate and maintained a 37^{o}C for 3-4 days. Antibacterial activity was determined by measuring the diameter of inhibition zone. Activity of each compound was compared with Ampicillin as standard [28, 29].

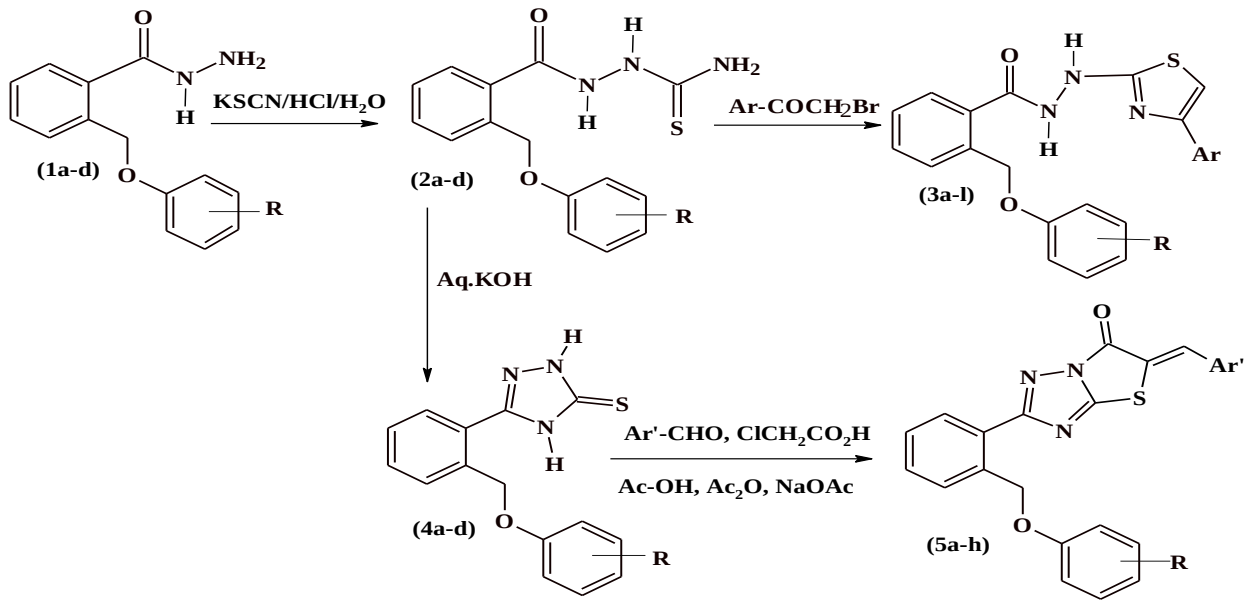
Antifungal activity: Newly prepared compounds were screened for their antifungal activity against *Aspergilus flovus* (NCIM No. 524), *Aspergilus fumigatus* (NCIM No. 902), *Penicillium maneffei* (recultured) and *Trichophyton mentagrophytes* (recultured) in DMSO by serial plate dilution method [30, 31]. Sabourands agar media was prepared by dissolving peptone (1g). D glucose (4g) and agar (2g) in distilled water (100 mL) and adjusting the pH to 5.7 Normal saline was used to make a suspension of sore of fungal strains for lawning. A loopful of particular fungal strain was transferred to 3 mL saline to get a suspension of corresponding species. Twenty milliliters of agar media was poured into each Petri dish. Excess of suspension was decanted and plated were dried by placing in an incubator at 37 ^{0}C for 1h. Using a punch wells were made on these seeded agar plates. Minimum inhibitory concentrations of the test compounds in DMSO were added into each labeled well. A control was also prepared for the plates in the same way using solvent DMSO. The Petri dishes were prepared in triplicate and maintained at 37 ^{0}C for 3-4 days. Antifungal activity was determined by measuring the diameter of inhibition zone. Activity of each compound was compared with Itraconozole as standard.

RESULTS AND DISCUSSION

Chemistry: The synthetic route for the target compounds was depicted in **Scheme 1**. 2-[2-(aryloxymethyl) phenyl]-*N′*-[4-(aryl)-thiazol-2yl]-benzohydrazide derivatives **3** were prepared from the reaction of 2-(aryloxymethyl)-benzo thioamide **2** with various substituted phenacyl bromides. The benzothiamide is

prepared from corresponding hydrazide in KSCN /HCl in methanol. 5-{2-[aryloxymethyl]-phenyl}-4*H*-1,2,4-triazole-3-thiol **4** was synthesized according to the procedure reported in the literature [32]. The condensation of **4** with monochloroacetic acid and substituted aldehydes in acetic acid in the presence of acetic anhydride and anhydrous sodium acetate afforded substituted thiazolo-[3,2-*b*]-[1,2,4]-triazole derivatives **5**.

The structures of newly synthesized compounds were confirmed by elemental analyses, IR, ^{1}H NMR and mass spectra. Characterization data of all the newly synthesized compounds are presented in table 1.



Scheme 1. Synthetic route for thiazoles **3(a-l)** and thiazolo-[3,2-*b*]-[1,2,4]-triazole **5(a-h)**

Table 1: Characterization data of 4-aryl-[2-(aryloxymethyl)phenyl]-thiazoles (**3a-l**) and 2-(2-aryloxyphenoxy) methyl]phenyl)ethyl-5-[arylmethylidene]-[1,3]thiazolo[3,2-*b*][1,2,4]trizol-6[5*H*]-one (**5a-h**)

Comp	R	Ar	Molecular Formula (M W)	M.P.(°C)	Yield (%)	% Analysis of C, H, N Found (calculated)		
						C	H	N
3a	2-CH_3	3-$CONH_2$-4-OH- C_6H_3	$C_{25}H_{22}N_4O_4S$ (474.5)	214-216	85	63.24 (63.28)	4.67 (4.67)	11.77 (11.81)
3b	3-CH_3	3-$CONH_2$-4-OH- C_6H_3	$C_{25}H_{22}N_4O_4S$ (474.5)	206-208	82	63.20 (63.28)	4.62 (4.67)	11.74 (11.81)
3c	4-CH_3	3-$CONH_2$-4-OH- C_6H_3	$C_{25}H_{22}N_4O_4S$ (474.5)	210-214	78	63.26 (63.28)	4.63 (4.67)	11.82 (11.81)
3d	4-Cl	3-$CONH_2$-4-OH- C_6H_3	$C_{24}H_{19}ClN_4O_4S$ (494.9)	223-225	86	58.26 (58.24)	3.84 (3.87)	11.28 (11.32)
3e	2-CH_3	5-Cl-2-SO_2NH_2-3-thienyl	$C_{22}H_{19}ClN_4O_4S_3$ (535.05)	166-168	78	49.25 (49.38)	3.52 (3.58)	10.46 (10.47)
3f	3-CH_3	5-Cl-2-SO_2NH_2-3-thienyl	$C_{22}H_{19}ClN_4O_4S_3$ (535.05)	158-160	78	49.32 (49.38)	3.58 (3.58)	10.46 (10.47)
3g	4-CH_3	5-Cl-2-SO_2NH_2-3-thienyl	$C_{22}H_{19}ClN_4O_4S_3$ (535.05)	178-180	76	49.30 (49.38)	3.54 (3.58)	10.40 (10.47)
3h	4-Cl	5-Cl-2-SO_2NH_2-3-thienyl	$C_{21}H_{16}Cl_2N_4O_4S_3$ (555.47)	194-196	80	45.40 (45.41)	2.84 (2.90)	10.12 (10.09)
3i	2-CH_3	4-NO_2-C_6H_4	$C_{24}H_{20}N_4O_4S$ (460.5)	162-164	78	62.54 (62.60)	4.36 (4.38)	12.20 (12.17)
3j	3-CH_3	4-NO_2-C_6H_4	$C_{24}H_{20}N_4O_4S$ (460.5)	166-167	76	62.54 (62.60)	4.38 (4.38)	12.12 (12.17)

Comp	R	Ar	Molecular Formula (M W)	M.P.(°C)	Yield (%)	% Analysis of C, H, N Found (calculated)		
						C	H	N
3k	4-CH_3	4-NO_2-C_6H_4	$C_{24}H_{20}N_4O_4S$ (460.5)	174-176	78	62.66 (62.60)	4.43 (4.38)	12.22 (12.17)
3l	4-Cl	4-NO_2-C_6H_4	$C_{23}H_{17}ClN_4O_4S$ (480.9)	183-185	82	57.46 (57.44)	3.58 (3.56)	11.62 (11.65)
5a	2-CH_3	3,4,5 Cl_3-C_6H_2	$C_{25}H_{16}Cl_3N_3O_2S$ (528.8)	188-190	76	56.74 (56.78)	3.04 (3.05)	7.90 (7.95)
5b	3-CH_3	3,4,5 Cl_3-C_6H_2	$C_{25}H_{16}Cl_3N_3O_2S$ (528.8)	176-178	76	56.70 (56.78)	3.08 (3.05)	7.96 (7.95)
5c	4-CH_3	3,4,5 Cl_3-C_6H_2	$C_{25}H_{16}Cl_3N_3O_2S$ (528.8)	181-183	76	56.66 (56.78)	3.11 (3.05)	7.88 (7.95)
5d	4-Cl	3,4,5 Cl_3-C_6H_2	$C_{24}H_{13}Cl_4N_3O_2S$ (549.2)	202-204	76	52.44 (52.48)	2.32 (2.39)	7.60 (7.65)
5e	2-CH_3	6-methoxy 2-naphthyl	$C_{30}H_{23}N_3O_3S$ (535.05)	152-154	78	71.20 (71.27)	4.56 (4.59)	8.32 (8.31)
5f	3-CH_3	6-methoxy 2-naphthyl	$C_{30}H_{23}N_3O_3S$ (535.05)	159-161	78	71.22 (71.27)	4.52 (4.59)	8.26 (8.31)
5g	4-CH_3	6-methoxy 2-naphthyl	$C_{30}H_{23}N_3O_3S$ (535.05)	155-157	78	71.26 (71.27)	4.66 (4.59)	8.30 (8.31)
5h	4-Cl	6-methoxy 2-naphthyl	$C_{29}H_{20}ClN_3O_3S$ (526.0)	168-170	78	66.20 (66.22)	3.86 (3.83)	7.96 (7.99)

The IR spectrum of the thiosemicarbazide **2a** showed the characteristic NH and NH_2 absorptions at 3425 cm^{-1}, 3253 cm^{-1} and 3196 cm^{-1}. A strong absorption bands at 1687 cm^{-1} was due to the presence of amide C=O. The C=S moiety shown a sharp absorption band at 1255 cm^{-1}. Further, cyclization of 2**a** to 2-[2-(4-chlorophenoxy methyl)-phenyl]-4-(2,3,5-trichlorophenyl)-thiazole **3h** was confirmed from its IR spectrum, which showed absorption bands at 2978, 1665, 1580 and 1072 cm^{-1} for CH_3, C=N, C=C and C-S groups respectively. The disappearance of characteristic absorption bands due to $–NH_2$ group of **2d** clearly indicated its transformation to yield **3h**. ^{1}H NMR spectra of **3e** showed showed two singlets at δ 2.18 and 5.28, which correspond to Ar-CH_3 and $–OCH_2$ protons respectively. The aromatic protons ring B appeared as two distinct doublets at δ, 6.83 ppm (J=8.8 Hz) and δ, 6.90 ppm (J= 8.8 Hz). The only one thiazole proton present in the molecule was resonated as a singlet at δ, 7.44 and single proton of Ring-C appear at δ, 7.50 as singlet.The four aromatic protons of ring A appeared as a complex multiplet in the region δ, 7.57-7.69 ppm and a singlet at δ, 7.94 ppm for SO_2NH_2 proton of ring-C. Two singlets at δ, 10.16 and δ, 10.90 is due to NH protons. Further, ^{13}C NMR spectrum of **3e** manifested signals at δ, 16.66 ppm δ, 66.98 ppm due to Ring-A CH_3 and -OCH_2. Peaks at δ, 109.97 ppm (C_2H of ring A), 111.79 ppm (C_3H of ring A), 120.95 ppm (C_5H of ring A), 126.51 ppm (C_6H of ring A), 127.39 ppm (C_4H of ring A), 128.31 and 128.70 ppm (C_2H and C_6H of ring B), 130.04 and 131.01 ppm (C_3H and C_4H of ring B),131.39 ppm (C_3H of thiophene), 133.07 ppm (C_6H of ring B), 134.70 ppm (C_1H of Ring B), 136.71 ppm (C_2 of ring C), 137.69 ppm (C_5 of ring C), 144.04 (C_4 of ring B), 152.41 ppm (C_5H of thiazole), 156.65 ppm (C_1H of Ring A), 168.62 ppm (C_2 of thiazole group) and 172.99 ppm corresponding to C=O group respectively. The peaks at δ, 16.66, 66.98, 109.97, 111.79, 120.95, 127.39, 128.31, 130.04, 131.01, 131.39 and 152.41 ppm were observed in DEPT experiment. The other peaks at δ, 126.51, 133.07, 134.70, 136.71, 137.69, 144.04, 156.65, 168.62 and 172.99 ppm due to quaternary carbon atoms were disappeared on DEPT experimentation. Further, FAB MS spectrum showed the molecular ion peak at m/z 535 which corresponds to its molecular formula, $C_{22}H_{19}ClN_4O_4S_3$.

^{1}H NMR spectra of **4a** showed a down-field D_2O exchangeable broad singlet at δ, 12.03 ppm for its two tautomeric NH/SH protons. The downfield shift of NH/SH proton signals indicates tautomerism in the triazole ring. It showed singlets at δ, 2.17 and 5.35 corresponding to CH_3 and OCH_2 protons respectively. The aromatic protons ring A appeared as two distinct doublets at δ, 6.80 ppm (J=9.2 Hz) for 3, 4 aromatic protons and at δ, 7.04 ppm (J= 8.80 Hz) for 2, 5-aromatic protons. The thiazole proton resonated as a singlet at δ, 7.30 ppm. The 3, 4-aromatic protons ring B appeared as a triplet at δ, 7.55 ppm (J=7.6 Hz), where as 2, 5-aromatic protons resonated as a doublet at δ, 7.38 ppm (J=8.8 Hz) and at

7.86 ppm (J=8.8 Hz). In ^{13}C NMR spectrum**,** signals observed at δ, 20.54 and 67.97 ppm were assigned to CH_3 and -OCH_2 groups and peaks at δ, 114.98 ppm (C_2H and C_6H of ring A), 128.01 ppm (C_3H and C_5H of ring A), 128.21 (C_2H of ring B), 129.79 ppm (C_4H of ring A), 129.90 ppm (C_6H of ring B), 130.35 ppm (C_5H of ring B), 130.89 ppm (C_3 of ring B), 132.55 ppm (C_4 of ring B), 139.05 ppm (C_1 of ring B), 156.64 ppm (C_1H of Ring A), 167.72 ppm (C_2 of thiazole group) and 172.98 ppm (C_5 of thiazole group) respectively. Further, LC MS spectrum of **4a** showed the molecular ion peak at m/z 297 which corresponds to its molecular formula, $C_{16}H_{15}N_3OS$.

In the IR spectra of **5e**, all compounds displayed strong absorption bands in the regions 1760-1728 cm^{-1} (C=O) and 1632-1588 cm^{-1} (C=N), respectively. The absorption bands associated with other functional groups appeared in the expected regions. The absence of signals due to two protons of tautomeric NH/SH in ^{1}H NMR spectra of **5a-h** and the presence of a new singlet in the region δ = 7.92 to 8.22 ppm for exocyclic methyne proton of thiazolidinone ring confirmed the transformation of **4a** into the corresponding substituted thiazolo-[3,2-*b*]-1,2,4-triazole derivatives **5e**. Two distinct doublets observed for **5a** in their ^{1}H NMR spectra in the region δ = 8.10 to 8.12 ppm (aromatic proton of Ring -C) also confirmed their structures. Further, in ^{13}C NMR spectra, **5a-h** showed their characteristic -C=O carbon signal in the region δ = 174.24-178.30 ppm in addition to other characteristic signals of remaining carbon atoms.

Antibacterial activity: All the compounds **3(a-l)** and **5(a-h)** were screened for their in vitro antibacterial activity. The results of the study are given **Table 2**. The investigation of antibacterial screening data revealed that all the tested compounds **3a-l** and **5a-h** exhibit moderate to good inhibition in DMSO. The compound **3h** and **5d** showed comparatively good activity against all the bacterial strains. The good activity can be attributed to the presence of 4-chloro and pharmacologically active 5-chloro-2 sulfonamide thiophene and 2,3,5-trichloro phenyl moiety attached to thiazolotriazole ring. The compounds 3**d, 3e, 3f, 3g, 5a, 5b, 5c** and **5h** showed moderate activity. The results of the study are given table 2.

Table 2: Antibacterial activity data of the 4-aryl-[2-(aryloxymethyl)phenyl]-thiazoles and thiazolotriazoles

Compound	MIC [μg mL^{-1}] and zone of inhibition (mm) in parentheses			
	S. aureus	***E. coli***	***P. aeruginosa***	***K. pneumoniae***
3a	25(<10)	25(<10)	25(<10)	25(<10)
3b	25(<10)	25(<10)	25(<10)	25(<10)
3c	25(<10)	25(<10)	25(<10)	25(<10)
3d	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3e	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3f	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3g	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3h	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**
3i	25(<10)	25(<10)	25(<10)	25(<10)
3j	25(<10)	25(<10)	25(<10)	25(<10)
3k	25(<10)	25(<10)	25(<10)	25(<10)
3l	25(<10)	25(<10)	25(<10)	25(<10)
5a	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
5b	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
5c	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
5d	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**
5e	25(<10)	25(<10)	25(<10)	25(<10)
5f	25(<10)	25(<10)	25(<10)	25(<10)
5g	25(<10)	25(<10)	25(<10)	25(<10)
5h	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
Standard (Ampicillin)	1.56(22-30)	6.25(30-40)	6.25(25-33)	6.25(23-27)

Antifungal activity: The antifungal screening data also revealed that compounds **3d, 3h** and **5d** showed comparatively good activity against all the fungal strains. The good activity can be attributed to the presence of 4-chloro and pharmacologically active 5-chloro-2-sulfonamide thiophene and 2,3,5-trichloro phenyl moiety attached to thiazolotriazole ring. The compounds **3a, 3b, 3c, 5a, 5b, 5c** and **5h** exhibited moderate antifungal activity. The results of the study are given table 3**.**

Table 3: Antifungal activity data of the 4-aryl-[2-(aryloxymethyl) phenyl]-thiazoles and thiazolotriazoles

Compound	MIC [μg mL^{-1}] and zone of inhibition (mm) in parentheses			
	A. flavus	***A. fumigatus***	***P. marneffei***	***T. mentagrophytes***
3a	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3b	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3c	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
3d	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**
3e	25(<10)	25(<10)	25(<10)	25(<10)
3f	25(<10)	25(<10)	25(<10)	25(<10)
3g	25(<10)	25(<10)	25(<10)	25(<10)
3h	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**
3i	25(<10)	25(<10)	25(<10)	25(<10)
3j	25(<10)	25(<10)	25(<10)	25(<10)
3k	25(<10)	25(<10)	25(<10)	25(<10)
3l	25(<10)	25(<10)	25(<10)	25(<10)
5a	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
5b	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
5c	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
5d	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**	**6.25(16-20)**
5e	25(<10)	25(<10)	25(<10)	25(<10)
5f	25(<10)	25(<10)	25(<10)	25(<10)
5g	25(<10)	25(<10)	25(<10)	25(<10)
5h	12.5(11-15)	12.5(1 1-15)	12.5(11-15)	12.5(11-15)
Standard (Itraconozole)	1.56(22-30)	6.25(30-40)	6.25(25-33)	6.25(23-27)

APPLICATIONS

From the screening data revealed these newer thiazoles and thiazolo-[3,2-*b*]-1,2,4-triazole derivatives have good antimicrobial properties and further studies may results in the emergence of newer better agents with good efficacy.

CONCLUSIONS

The research study reports the successful synthesis of 2- [2-(aryloxymethyl)-phenyl]-*N′*-[4-(aryl)-thiazol-2yl]-benzohydrazide derivatives and substituted thiazolo-[3,2-*b*]-1,2,4-triazole derivatives and antimicrobial activities. The antimicrobial activity study revealed that synthesized compounds exhibit moderate to good activity against all the pathogenic strains. Compound **3h, 5d** showed good activity against all the bacterial strains and the compounds **3d, 3h** and **5d** showed comparatively good activity against all the fungal strains. The screening data showed that the newly prepared compounds have shown promising antibacterial and antifungal activities against the screened organisms. Therefore, it was concluded that there exists ample scope for further study in this class of compounds.

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