ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

SYNTHESIS OF SUBSTITUTED PHENYL TETRAZOLO AND TIAZOLO PYRIMIDIN-YL-*2H*-CHROMEN-2-ONES

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Manuscript Info

Manuscript History:

Received: 25 October 2014
Final Accepted: 26 November 2014
Published Online: December 2014

Key words:

ortho-salyciladehyde,amino tetrazole, aminotriazole, cinnamoyl coumarins.

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Abstract

A novel series of substituted phenyl tetrazolo/triazolo pyrimidinyl-2H-chromen-2-ones 4(a-e) and 5(a-e) in good yields by using o-salyciladehyde as raw material and 3-aryl-1-(3-coumarinyl)propen-1-ones 3(a-e) as intermediates. The chemical structures of the newly synthesized compounds have been characterized by IR, NMR, mass spectral and CHN analysis. All the title compounds are subjected to in vitro antibacterial testing against two pathogenic strains and antifungal screening against two fungi. Among the tested compounds, 4b and 4c show significant antibacterial and antifungal activities. Also the compound 5b show significant antifungal activity against Candida albicans.

Introduction

The pharmacologically important heterocycles with nitrogen bridge derived from tetrazole and 1,2,4-triazole paved the way toward active research in tetrazole and triazole chemistry. As a result, a variety of new improved compounds are being added to this field every year. A number of attempts were made to improve the activities of the compounds varying the substitution on the tetrazole and triazole nucleus. Tetrazoles have found broad applications in medicinal chemistry and pharmacology materials chemistry [1, 2]. They play an important role in coordination chemistry as ligands, in medicinal chemistry as stable surrogates for carboxylic acids and in materials applications, including explosives, rocket propellants, and agriculture [3–13].

The 1,2,4-tiazole derivatives possess antibacterial, antifungal,[14,15] antimycobacterial [16], antiviral [17], anti-inflammatory [18], anticonvulsant,[19] antidepressant [20], antitubercular [21], anti tumor [22], antihypertensive [23] analgesic [24], hypoglycemic [25] activities. On the other hand, coumarins are heterocyclic organic compounds which constitute an important group of natural products having varied biological activities such as antitumor, antiinflammatory, antiviral, CNS, antioxidant, and anti-HIV activities [26-29].

Thus in view of the diverse activity of tetrazoles, triazoles and coumarins as a part of our continuing research work on the synthesis of novel heterocyclic compounds, we thought to synthesize the compounds containing coumarin containing tetrazole and triazole moieties and also studied their antimicrobial activities.

Material and Methods:

Melting points were recorded in open capillary and were uncorrected. Column chromatography was performed using silicagel (100–200 mesh size) purchased from Thomas Baker and TLC was carried out using aluminium sheets precoated with silica gel 60F254 purchased from Merck. IR spectra (KBr) were recorded on a Bruker WM-4(X) spectrometer (577 model). ^{1}H NMR (300 MHz) and ^{13}C NMR (75 MHz) spectra were recorded on Bruker AC-300 spectrometer in DMSO-d_6 with TMS as an internal standard. Mass spectra (ESI) were recorded on

JEOL SX-102 spectrometer. CHN analysis was done by Carlo Erba EA 1108 automatic elemental analyzer. The chemicals and solvents used were of commercial grade and were used without further purification unless, otherwise, stated.

General Procedure

Synthesis of 3-aryl-1-(3-coumarinyl)propen-1-ones 3(a-e):

A mixture of 3-acetyl coumarin **(1)** (0.01mol) and substituted aromatic aldehyde (0.012 mol) in ethanol (10 ml) stirred at a temperature of 40-50 ºC, after 30 min, catalytic amount of glacial acetic acid and piperidine were added in the reaction mixture, refluxing was continued. After completion of reaction (monitored by TLC), solvent was completely removed by evaporation. The precipitate obtained was washed with methanol and recrystallized with methanol solvent to afford compounds in good yields.

Synthesis of 3-(3-phenyl acryloyl)-*2H*-chromen-2-one (3a):

m. p. 161–163 ^{0} C; IR (KBr, cm^{-1}): 1670, 1541 ; ^{1}H NMR (300 MHz, DMSO-d_6): δ 6.94 (d, 1H, =CH), 7.42 (d,1H,,=CH), 7.34 (dd,2H,Ar-H), 7.48–7.54 (m, 5H, Ar-H), 7.72(t,1H,Ar-H), 7.88 (d, 1H, Ar-H), 8.72 (s, 1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.0, 119.2, 126.2, 126.5, 126.9, 128.2, 129.4, 129.8, 130.4, 137.2, 144.2, 144.8, 154.6, 184.3; MS (*m/z):* 277 $(M+1)^+$; Anal.Calcd for $C_{18}H_{12}O_3$: C, 78.25; H, 4.38; Found: C, 78.22; H, 4.30 %.

Synthesis of 3-(4-methoxyphenyl acryloyl)-*2H*-chromen-2-one (3b):

m. p. 152–154 ^{0} C; IR (KBr, cm^{-1}): 1672, 1554, 1172; ^{1}H NMR (300 MHz, DMSO-d_6): δ 3.82 (s,3H,-OCH_3), 7.02 (dd,1H,=CH),7.04(d,1H, Ar-H), 7.45 (dd,1H,=CH), 7.48–7.54 (m, 3H, Ar-H), 7.72- 7.76 (m,4H,Ar-H), 7.92-7.94 (d,1H,Ar-H), 8.69 (s, 1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 56.2, 115.3, 117.4, 119.6, 126.4, 126.9, 127.8, 128.0, 129.2, 131.4, 135.2, 142.8, 147.4, 153.2, 160.2, 160.4, 190.0; MS (*m/z):* 308 $(M+1)^+$; Anal.Calcd for $C_{19}H_{14}O_4$: C, 74.50; H, 4.61; Found: C, 74.42; H, 4.58 %.

Synthesis of 3-(3-(2-hydroxy phenyl) acryloyl)-*2H*-chromen-2-one (3c):

m. p: Semi solid; IR (KBr, cm^{-1}): 3324, 1678, 1548, ^{1}H NMR (300 MHz, DMSO-d_6): δ 6.92-6.94 (dd, 2H,Ar-H), 7.04 (d,1H,=CH), 7.42 (d,1H,,=CH), 7.28–7.32 (m, 2H, Ar-H), 7.52- 7.64 (m, 4H, Ar-H), 7.92 (dd,1H, Ar-H), 8.65 (s, 1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 116.4, 118.2, 121.4, 123.4, 126.8, 127.5, 130..2, 131.4, 133.2, 141.2, 146.5, 154.7, 160.5, 161.2, 191.4; MS (*m/z):* 293 $(M+1)^+$; Anal.Calcd for $C_{18}H_{12}O_4$: C, 73.97; H, 4.14; Found: C, 73.91; H, 4.08 %.

Synthesis of 3-(3-(2,4-dichloro phenyl) acryloyl)-*2H*-chromen-2-one (3d):

m. p: 222-225 ^{0}C IR (KBr, cm^{-1}): 1678, 1462 1082; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.00 (d,1H,=CH), 7.28–7.42 (m, 7H, Ar-H), 7.47 (d,1H,=CH), 7.92 (dd,1H, Ar-H), 8.71 (s, 1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.2, 118.9, 126.5, 125.4, 127.6, 128.2, 128.9, 129.0, 131.4, 132.7, 134.2, 135.8, 137.0, 148.2, 153.0, 153.6, 160.4, 184.2; MS (*m/z):* 346 $(M+1)^+$; Anal.Calcd for $C_{18}H_{10}Cl_2O_3$: C, 62.63; H, 2.92; Found: C, 62.58; H, 2.85 %.

Synthesis of 3-(3-pyridin-3-yl) acryloyl)-*2H*-chromen-2-one (3e):

m. p: 143-145 ^{0}C IR (KBr, cm^{-1}): 1682, 1462; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.12 (d,1H,=CH),7.50 (d, 1H,=CH), 7.52-7.68 (m, 4H, Ar-H), 7.68-7.74 (dd, 2H, Pyridin-H), 8.64 (m, 2H, Pyridin-H), 8.68 (s, 1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 116.9, 119.7, 124.5, 125.4, 127.9, 129.2, 132.5, 134.7, 135.3, 148.7, 148.9, 150.2, 151.9, 152.8 153.6, 160.8, 183.7; MS (*m/z):* 288 $(M+1)^+$; Anal.Calcd for $C_{17}H_{11}NO_3$: C, 73.64; H, 4.00; N, 5.05; Found: C, 73.57; H, 3.92 ; N, 5.01%.

Synthesis of Substituted phenyl tetrazolo/triazolo pyrimidinyl)-*2H*-chromen-2-ones 4(a-e) and 5(a-e):

Compound 3-aryl-1-(3-coumarinyl)propen-1-ones **3(a-e)** in glacial acetic acid (15 mL) was stirred at room temperature for 10 mints. To this, compounds 5-aminotetrazole and 3-amino[1,2,4]-triazole (0.01 mol) was added portion wise added along with a catalytic amount of DMF to the reaction mixture and then it was stirred at reflux temperature for appropriate time (5-7 h). After completion of the reaction (monitored by TLC), cooled to room temperature and poured into ice cold water, the solid separated out was filtered, washed with water, dried and purified by column chromatography using silicagel (EA: Pet. Ether: 4:6) to afforded the title compounds in good yields.

Synthesis of 3-(7-phenyltetrazolo[1,5-a]pyrimidin-5-yl)-2H-chromen-2-one (4a):

m. p: 182-184 ^{0}C IR (KBr, cm^{-1}): 1710, 1674; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.12 (d, 2H, Ar-H), 7.46 (t, 1H, Ar-H), 7.50 (t, 2H, Ar-H), 7.55 (t, 1H,Ar-H) 7.65(s, 1H,Ar-H), 7.72 (t, 2H, Ar-H), 7.88 (d, 1H,Ar-H), 8.21 (s, 1H, coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.2,119.4, 121.7, 127.5, 128.5, 128.0, 129.0, 129.6, 130.8, 131.4, 134.2, 145.4, 147.4, 152.0, 152.6, 163.4, 185.2; MS (*m/z):* 342 $(M+1)^+$; Anal.Calcd for $C_{19}H_{11}N_5O_2$: C, 66.86; H, 3.25, N, 20.52; Found: C, 66.82; H, 3.20; N,20.46 %.

Synthesis of 3-(7-(4-methoxyphenyl) tetrazolo *[1, 5-a]* pyrimidin-5-yl)-2H-chromen-2-one (4b):

m. p. 180–182 ^{0} C; IR (KBr, cm^{-1}): 1712, 1654, ^{1}H NMR (300 MHz, DMSO-d_6): δ 3.86 (s,3H, OCH_3), 7.12-7.14 (d, 2H, Ar-H), 7.42-7.50 (m,2H, Ar-H), 7.59-7.62 (d, 2H, Ar-H), 7.65 (t,1H,,Ar-H), 7.69 (s, 1H, Ar-H), 7.72 (d, 1H, Ar-H), 8.78 (s, 1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 56.4, 117.2, 119.3, 121.4, 125.7, 126.5, 128.4, 129.0, 129.7, 130.4, 147.4, 149.2, 151.5, 154.7, 157.2, 162.2, 164.8, 165.0; MS (*m/z):* 372 $(M+1)^+$; Anal.Calcd for $C_{20}H_{13}N_5O_3$: C, 64.69; H, 3.53; N, 18.86; Found: C, 64.61; H, 3.48; N,18.82 %.

Synthesis of 3-(7-(2-hydroxyphenyl) tetrazolo *[1,5-a]* pyrimidin-5-yl) -2H-chromen-2-one (4c):

m. p. 165–167 ^{0} C; IR (KBr, cm^{-1}): 3310, 1712, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 4.80 (br,1H,-OH), 7.22-7.28 (m, 3H, Ar-H), 7.40-7.45 (m,2H, Ar-H), 7.50-7.54 (d, 2H, Ar-H), 7.68 (t,1H,,Ar-H), 7.73(s,1H,Ar-H), 8.12(d,1H,Ar-H), 8.72(s,1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.5, 119.5, 120.4, 121.0, 121.4, 122.4, 125.4, 127.9, 128.8, 131.4, 133.5, 134.6, 142.2, 145.2, 156.5, 156.8, 163.7, 165.5; MS (*m/z):* 359 $(M+1)^+$; Anal.Calcd for $C_{19}H_{11}N_5O_3$: C, 63.86; H, 3.10; N, 19.60; Found: C, 63.81; H, 3.04; N,19.54 %.

Synthesis of 3-(7-(2,3-dichlorophenyl) tetrazolo *[1, 5-a]* pyrimidin-5-yl)-2H-chromen-2-one (4d):

m. p. 192–194 ^{0} C; IR (KBr, cm^{-1}): 1710, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.28-7.36 (m, 3H, Ar-H), 7.45-7.52 (m,2H, Ar-H), 7.58-7.65 (d, 2H, Ar-H), 7.79(s,1H,Ar-H), 8.68(s,1H, C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.9, 119.2, 121.6, 126.5, 128.0, 128.2, 129.2, 129.6, 129.9, 130.2, 131.9, 133.5, 135.2, 136.9, 147.2, 153.8, 154.8, 162.9, 166.2; MS (*m/z):* 411 $(M+1)^+$; Anal.Calcd for $C_{19}H_9Cl_2N_5O_2$: C, 55.63; H, 2.21; N, 17.07; Found: C, 55.57; H, 2.19; N,17.11 %.

Synthesis of 3-(7-(pyridyl)tetrazolo*[1, 5-a]* pyrimidin-5-yl)-2H-chromen-2-one (4e):

m. p. 220–222 ^{0} C; IR (KBr, cm^{-1}): 1714, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.45-7.48 (m, 2H, Ar-H), 7.65 (s, 1H, Ar-H), 7.72-7.76 (m, 2H, Ar-H), 7.89-8.02 (m, 4H,Ar-H), 8.72(s,1H,C4 of coumarin-H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.2, 118.7, 121.3, 125.5, 126.5, 128.9, 129.3, 130.2, 134.0, 138.2, 145.9, 148.5, 149.2, 154.7, 155.4, 163.2, 165.8; MS (*m/z):*343 $(M+1)^+$;Anal.Calcd for $C_{18}H_{10}N_6O_2$:C, 63.16; H, 2.94; N, 24.55; Found: C, 63.10; H, 2.87; N,24.52 %.

Synthesis of 3-(5-phenyl-[1,2,4]triazolo*[4,3-a]* pyrimidin-7-yl)-2H-chromen-2-one (5a):

m. p: 192-193 ^{0}C IR (KBr, cm^{-1}): 1710, 1670; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.10 (d, 2H, Ar-H), 7.43 (t, 2H, Ar-H), 7.48 (t, 1H, Ar-H), 7.52 (t, 1H,Ar-H) 7.63(s, 1H,Ar-H), 7.69 (t, 2H, Ar-H), 7.75 (d, 1H,Ar-H), 8.59 (s, 1H, coumarin-H), 8.72 (s,1H,-CH); ^{13}C NMR (75 MHz, DMSO-d_6): δ 118.4, 119.8, 126.2, 128.4, 128.7, 129.0, 129.8, 130.2, 130.8, 131.7, 132.9, 140.5, 147.7, 153.6, 154.2, 163.9, 165.4 166.2; MS (*m/z):* 341 $(M+1)^+$; Anal.Calcd for $C_{20}H_{12}N_4O_2$: C, 70.55; H, 3.55, N, 16.46; Found: C, 70.47; H, 3.49; N,16.40 %.

Synthesis of 3-(5-(4-methoxyphenyl-[1,2,4]triazolo*[4,3-a]* pyrimidin-7-yl)-2H-chromen-2-one (5b):

m. p. 212–214 ^{0} C; IR (KBr, cm^{-1}): 1712, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 3.80 (s, 3H, -OCH_3), 7.10-7.12 (d, 2H, Ar-H), 7.42-7.46 (m, 2H, Ar-H), 7.49-7.60 (d, 2H, Ar-H), 7.58 (t,1H,,Ar-H), 7.67 (s, 1H, Ar-H), 7.72 (d, 1H, Ar-H), 8.54 (s, 1H, C4 of coumarin-H) 8.79 (s,1H, -CH); ^{13}C NMR (75 MHz, DMSO-d_6): δ 55.2, 115.5, 119.5, 120.5, 125.9, 127.3, 128.5, 129.7, 130.5, 131.2, 147.6, 148.3, 151.7, 155.2, 156.7, 160.4, 162.8, 163.8, 164.6; MS (*m/z):* 371 $(M+1)^+$; Anal.Calcd for $C_{21}H_{14}N_4O_3$: C, 68.10; H, 3.81; N, 15.13; Found: C, 68.05; H, 3.74; N,15.09 %.

Synthesis of 3-(5-(2-hydroxyphenyl-[1,2,4]triazolo*[4,3-a]*pyrimidin-7-yl)-2H-chromen-2-one (5c):

m. p. 158–160 ^{0} C; IR (KBr, cm^{-1}): 1710, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 4.80 (br,1H,-OH), 7.28-7.42 (m, 5H, Ar-H), 7.47-7.54 (d,2H,Ar-H), 7.65 (t, 1H,,Ar-H), 7.73 (s, 1H, Ar-H), 8.12 (d,1H, Ar-H), 8.50 (s,1H, C4 of coumarin-H), 8.69 (s,1H,-CH); ^{13}C NMR (75 MHz, DMSO-d_6): δ 116.9, 118.2, 120.7, 121.5, 122.9, 124.2, 126.7, 128.9, 129.5, 130.0, 131.8, 132.3, 142.7, 146.2, 153.5, 155.7, 156.8, 162.3, 163.5, 165.8; MS (*m/z):* 357 $(M+1)^+$; Anal.Calcd for $C_{20}H_{12}N_4O_3$: C, 67.41; H, 3.39; N, 15.72; Found: C, 67.37; H, 3.32; N,15.65 %.

Synthesis of 3-(5-(2,3-dichlorophenyl-[1,2,4]triazolo*[4,3-a]*pyrimidin-7-yl)-2H-chromen-2-one (5d):

m. p. 230–232 ^{0} C; IR (KBr, cm^{-1}):1712, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.22-7.30 (m,3H,Ar-H), 7.37-7.42 (m, 2H, Ar-H), 7.54-7.58 (d, 2H, Ar-H), 7.74 (s,1H,Ar-H), 8.58(s,1H, C4 of coumarin-H), 8.70 (s,1H,-CH); ^{13}C NMR (75 MHz, DMSO-d_6): δ 116.5, 118.7, 121.3, 126.9, 127.4, 128.2, 129.5, 129.9, 130.9, 131.2, 131.9, 133.6,

135.0, 137.2, 147.4, 153.5, 154.8, 162.9, 164.2, 165.3; MS (*m/z):* 409 $(M+1)^+$; Anal.Calcd for $C_{20}H_{10}Cl_2N_4O_2$: C, 58.70; H, 2.46; N, 17.33; Found: C, 58.64; H, 2.40; N,17.27 %.

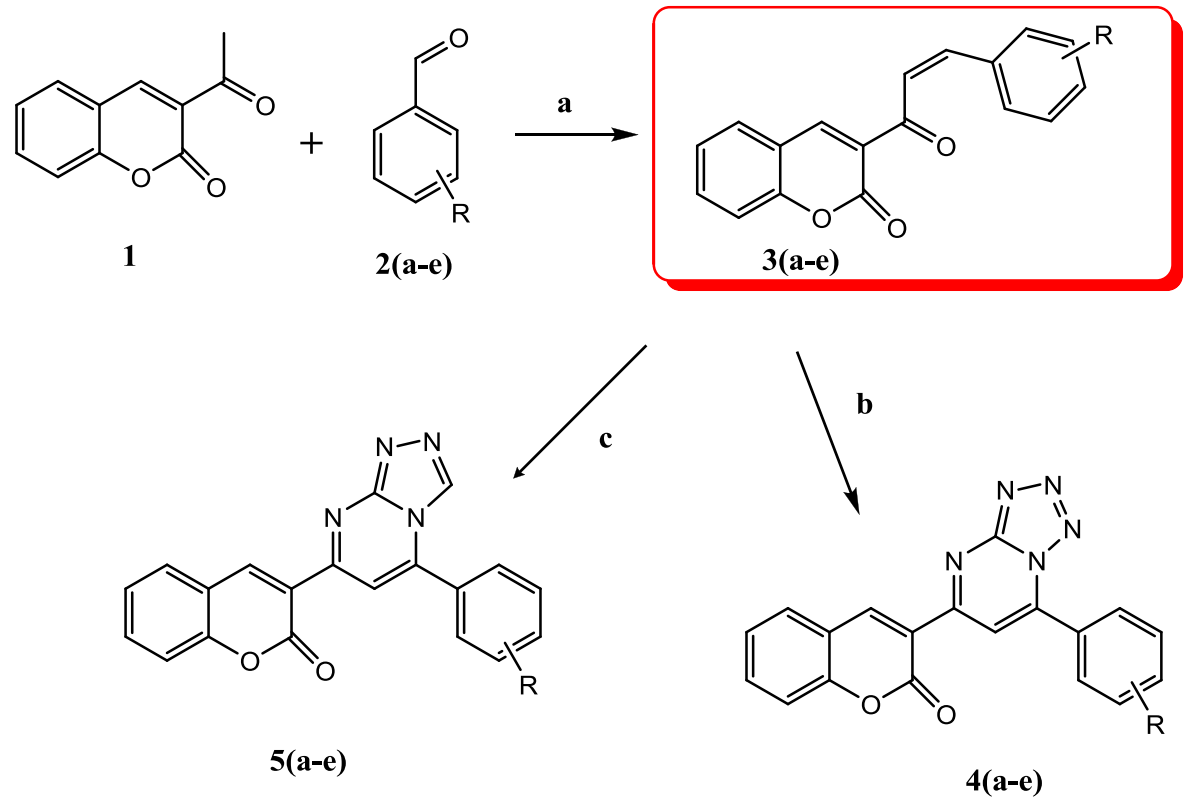
Synthesis of 3-(5-(pyridyl-[1,2,4]triazolo*[4,3-a]*pyrimidin-7-yl)-2H-chromen-2-one (5e):

m. p. 196–198 ^{0}C; IR (KBr, cm^{-1}): 1715, 1672; ^{1}H NMR (300 MHz, DMSO-d_6): δ 7.40-7.46 (m, 2H, Ar-H), 7.69 (s, 1H, Ar-H), 7.74-7.79 (m, 2H, Ar-H), 7.92-8.10 (m, 4H,Ar-H), 8.62 (s,1H,C4 of coumarin-H), 8.72 (s,1H,-CH); ^{13}C NMR (75 MHz, DMSO-d_6): δ 117.9, 119.2, 121.0, 124.2, 126.8, 127.9, 128.6 131.2, 133.5, 136.2, 143.5, 144.8, 150.4, 153.2, 155.4, 162.3, 163.8, 167.6; MS (*m/z):*342 $(M+1)^+$;Anal.Calcd for $C_{19}H_{11}N_5O_2$:C, 66.86; H, 3.25; N, 20.52; Found: C, 66.80; H, 3.19; N,20.46 %.

Results and Discussion:

The proposed way of proceeding for the synthesis of substituted phenyl tetrazolo *[1,5-a]* pyrimidin-5-yl-*2H*-chromen-2-ones **4(a-e)** and substituted phenyl traizolo[4,3-a] pyrimidin-7-yl-*2H*-chromen-2-ones **5(a-e)** were depicted in **Scheme 1**. The starting compounds cinnomoyl coumarins **3(a-e)** synthesized by the reaction of 3-acetyl coumarin **1** with aromatic aldehydes **2(a-e)** in the presence of piperidine as a catalyst in ethanol. The 3-aryl-1-(3-coumarinyl) propen-1-ones **3(a-e)** dissolved in acetic acid were reacted with 5-aminotetrazole and 3-amino triazole at reflux conditions. The cinnomoyl coumarins **3(a-e)** showed IR absorption frequencies at 1672-1695 and 1420-1468 cm^{-1} for lactone (-C=O) and –C=C- respectively. The IR spectra of the resulted coumarino tetrazoles and triazoles shows absorption at 1692-1715, 1567-1610 and 1460-1490 cm^{-1} for –C=O, C=N and C=C respectively. The ^{1}H NMR spectra of the compounds **3(a-e)** shows ethylenic protons peaks at δ 6.94-7.12 and δ 7.45-7.50 as doublets but these peaks were disappeared in both compounds **4(a-e)** and **5(a-e)** confirmed the formation of tetrazole and triazole containing coumarins. Structures of all the newly synthesized compounds were characterized on the basis of elemental analysis, IR, mass, ^{1}H NMR and ^{13}C NMR data. The synthesized compounds were also screened for their anti microbial activity.

Scheme-1:



Antimicrobial activity

The agar disc-diffusion method[30] was used for the screening of *in vitro* antimicrobial activity. The anti-microbial activity of the synthesized compounds **4(a-e)** and **5(a-e)** were screened against *Staphylococcus aureus* and

Escherichia Coli using nutrient agar medium. The antifungal activity of the compounds was tested against *Candida albicans* and *Aspergillus niger* using Sabouraed dextrose agar medium. The minimum inhibitory concentration (MIC) was carried out using micro dilution susceptibility method[31]. Ciprofloxacin was used as a standard antibacterial drug and Flucanazole was used as a standard antifungal drug. The observed data on the antimicrobial activity of compounds and control drugs are given in **Table I**.

The investigation of antibacterial screening **Table I** revealed that some of the newly synthesized compounds showed moderate to good inhibition at 25-100 µg/mL in DMSO. Amongst all the compounds, compounds **4b**, **4c** showed excellent antibacterial activity against *E-Coli* (MIC: 25µg/mL) and *S. aureus* (MIC: 25 µg/mL). Compounds **5b** and **5d** were displayed good activity against *S. aureus* (MIC: 50µg/mL). Compounds **5a, 5e, 4a** and **4e** exhibited moderate activity against *S. aureus and E. coli.*

The investigation of antifungal screening **Table I** revealed that some of the newly synthesized compounds showed moderate to good inhibition at 25-100 µg/mL in DMSO. Amongst the tested compounds, compounds **4b** and **4c** shows excellent inhibitory growth against *C. albicans* (MIC: 25 µg/mL) and *A niger* (MIC: 25 µg/mL) respectively. Compound **5b** showed excellent activity against *C. albicans* where as compounds **5d, 5e** and **4d** exhibited good activity against *A. niger*. Remaining compounds showed moderate to least activity against both bacteria and fungi.

Biological protocol

Antimicrobial activity

Preliminary antimicrobial activities of compound **4(a-e)** and **5(a-e)** were tested by Agar disc diffusion method. Sterile filter paper discs (6 mm diameter) monitored with the test compound solution in DMSO of specific concentration 100 and 200 µg/mL disc were carefully placed on the agar culture plates that had been previously incubated separately with the micro organisms. The plates were incubated at 37°C and the diameter of the growth inhibition zones were measured after 24 hr in case of bacteria and after 48 hr in case of fungi. The MICs of the compound assays were carried out using micro dilution susceptibility method. Ciprofloxacin was used as reference for antibacterial activity agent. Flucanazole was used as reference for anti fungal agent. The test compounds, Ciprofloxacin and Flucanazole were dissolved in DMSO at concentration of 800 µg/mL and two fold serial dilution of the solution was prepared (400, 200, 100,.,...6.25µg/mL). The microorganism suspensions were inoculated to the corresponding wells. The plates were incubated at 37°C for 24 hr and 48 hr for bacteria and fungi respectively. The minimum inhibitory concentration (MIC: µg /mL) of the compounds were recorded as the lowest concentration of each chemical compounds in the tubes without turbidity (i.e. no growth) of inoculated bacteria/fungi.

Table-1: Minimum inhibitory concentration (MIC, µg/ml) of synthesized compounds 4(a-e) and 5(a-e)

	Bacterial strains (+ Ve and –Ve)		**Fungal strains**	
Compound	***S. aureus***	***E. coli***	***C. albicans***	***A. niger***
4a	200	100	400	400
4b	25	25	25	25
4c	25	25	25	25
4d	400	400	200	50
4e	200	100	400	400
5a	200	200	400	400
5b	50	400	25	400
5c	400	400	400	400
5d	50	400	100	50
5e	100	100	400	40

Ciprofloxacin	6.25	6.25		
Flucanazole			6.25	6.25

Conclusions:

The results of the study described above have led to the development of a simple approach for the synthesis of a novel class of substituted phenyl tetrazolo/triazolo pyrimidinyl)-*2H*-chromen-2-ones with potentially interesting biological properties. Furthermore, all the newly synthesized compounds were screened for their *in vitro* antimicrobial activity. Among the screened samples **4b** and **4c** showed significant antibacterial and antifungal activities compared to other tested samples.

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