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Synthesis of Novel Series of Quinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepines Derivatives Incorporated with 3-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl] Moiety as Potent Antimicrobial Agent

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A novel series of quinolino[3,2-*f*][1,2,4]triazolo[3,4-b][1,3,4]thiadiazepine derivatives (**7a-i**) incorporated with 3-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl] moiety were synthesized through one-pot cyclo-condensation reaction of 5-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-4-amino-4*H*-1,2,4-triazole-3-thiol (**4**) with 2-chloroquinoline-3-carbaldehyde derivatives (**6a-i**) in presence of potassium carbonate in DMF. The characterization of newly synthesized compounds 3-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-substituted quinolino[3,2-f][1,2,4]triazolo[3,4-b][1,3,4]thiadiazepines (**7a-i**) was established by elemental analysis and spectral studies such as FT-IR, ^{1}H NMR, ^{13}C NMR and Mass spectra. All the synthesized compounds were screened *in vitro* for their antimicrobial activity against pathogenic microorganism including Gram-positive bacterial strains, *S. aureus* and Gram-negative bacteria strains *E. coli, P. vulgaris* and *S. typhi* at different concentration. The result of bioassay when compared with chloramphenicol as standard drug indicated good to moderate activity against these microbial strains.

Keywords: 1,3,4-Thiadiazepine, 1,2,4-Triazole, Quinoline, Benzofuran, Pyrazole.

INTRODUCTION

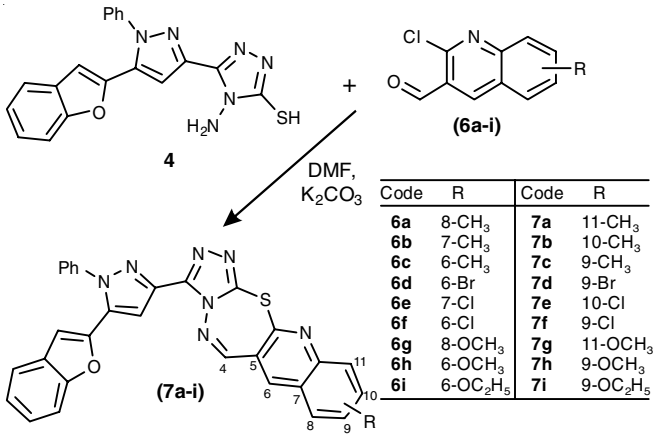
Rapid rise in bacterial resistance towards available antibiotics is becoming a major threat to human health. Therefore, design of new class of compounds, with novel and distinct mode of action, from those of well-known classes, is of prime interest. In recent years, a large number of fused heterocycles derived from 1,3,4-thiadiazepines having one sulphur and two nitrogen atoms at 1, 3 and 4 position in seven membered heterocyclic ring system has received much attention due to their synthetic and effective biological importance [1]. Heterocyclic compounds containing nitrogen and sulfur were found to play important role in medicinal and pharmaceutical chemistry due to the presence of the N=C-S group. In recent years attention has been increasingly paid to the synthesized *bis*-heterocyclic compounds belonging to seven membered ring of thiadiazepine series constitutes an important research area due to various impressive array of diverse biological activities [1-3], including cytotoxic DNA cleavage [4], neurodegenerative diseases [5], CCK antagonists [6], antifungal [7-9], analgesic [10], antioxidant [11], anticancer [12,13], antitumor [14], antiviral [15], antidepressant [16], potential antipsychotics [17] antimalarial and diuretic [18], cardiovascular disease [19], anti-inflammatory [20], antidepressant [21], antihistamine activity [22], gastrin receptor antagonists [23], anti-HIV activity [24], HIV-1RT inhibitors [25], antituberculosis activity [26], metalloproteinase inhibition [27], antibacterial activity [28-32] and charge generating agents [33].

Owing to the immense importance and varied bioactivities exhibited by 1,3,4-thiadiazepine and quinoline ring system, we were inspired to integrate thiadiazepine moieties in a triazole framework, with fused quinoline moiety since these systems possess well documented biological activity. 5-(5-(Benzo-furan-2-yl)-1-phenyl-1*H*-pyrazol-3-yl)-4-amino-4*H*-1,2,4-triazole-3-thiol [34] is used as an intermediate because the amino and mercapto groups are appropriate nucleophile centers in synthesis which on cyclocondensation with 2-chloro-quinoline-3-carbaldehyde (**6a-i**) gives 1,3,4-thiadiazepine derivatives (**7a-i**) as target compounds.

EXPERIMENTAL

Chemicals used for the synthesis were of AR grade of Merck, S.D. Fine and Aldrich. The reactions were monitored by E. Merck TLC aluminum sheet silica gel$_{60}$ F_{254} and visualizing the spot in UV Cabinet and iodine chamber. IR spectra were recorded on a Shimadzu IR spectrophotometer (KBr, ν_{max}, cm^{-1}). ^1H NMR spectra are recorded on a Bruker AM 400 instrument (400 MHz) using tetramethylsilane (TMS) as an internal reference and DMSO-d_6 as solvent. Chemical shifts are given in parts per million (ppm). Positive-ion Electro Spray Ionization (ESI) mass spectra were obtained with a Waters Micromass Q–TOF Micro, Mass spectrophotometer. The melting points were recorded in open capillary in paraffin bath and are uncorrected. Elemental (CHN) analysis was done using Thermo Scientific (Flash-2000), the compounds were analyzed for carbon, hydrogen and nitrogen and the results obtained are in excellent conformity with the premeditated values. The compounds are purified by using column chromatography on silica gel (60-120 mesh).

General procedure for the synthesis of 3-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-11-methylquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazepines (7a): 2-Chloro-8-methyl quinoline-3-carbaldehyde (2.05 g, 10 mmol) and potassium carbonate (1.38 g, 10 mmol) were added in 5-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-4-amino-4*H*-1,2,4-triazole-3-thiol [34] (3.74 g, 10 mmol) in DMF (30 mL) as solvent and the reaction mixture was refluxed for 8 h. It was then concentrated and poured in ice-cold water and the solid separated out was filtered and recrystallized from ethanol to get **7a** as yellow amorphous solid (yield 82 %); m.p. 220 °C; m.f. $C_{30}H_{19}N_7OS$. Correspondingly, other 3-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-substituted quinoline [3,2-*f*][1,2,4]-triazolo[3,4-*b*][1,3,4]thiadiazepines (**7b-i**) were synthesized from **4** and (**6b-i**) by similar procedure as followed for **7a** (**Scheme-I**).



Code	R	Code	R
6a	8-CH_3	**7a**	11-CH_3
6b	7-CH_3	**7b**	10-CH_3
6c	6-CH_3	**7c**	9-CH_3
6d	6-Br	**7d**	9-Br
6e	7-Cl	**7e**	10-Cl
6f	6-Cl	**7f**	9-Cl
6g	8-OCH_3	**7g**	11-OCH_3
6h	6-OCH_3	**7h**	9-OCH_3
6i	6-OC_2H_5	**7i**	9-OC_2H_5

Scheme-I: Synthesis of 1,3,4-thiadiazepines

Spectral data analysis for 7a-i:

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-11-methylquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7a): Colour: Yellow, m.p.: 185 °C, Yield: 85 %, R_f: 0.65. IR (KBr, ν_{max}, cm^{-1}): 3067 (C-H str., Ar-H), 2926 (C-H asym. str., -CH_3), 2811 (C-H sym. str., CH_3), 1496 (C-H i.p. def.), 1373 (C-H o.o.p. def.), 1496, 1518, 1565, 1612 (C=C str., in aromatic region), 1073 (C-H i.p. def., aromatic), 802,849 (C-H. o.o.p. def., aromatic), 1612,1565 (C=N str., triazole), 1227 (C-N str., triazole), 1000 (N-N str.), 693,718 (C-S-C str., thiadiazepines ring), 1256 (C-O-C sym. str.), 1073 (C-O-C asym. str.). ^1H NMR δ ppm (DMSO-d_6): 6.52 (s, 1H, at C_4 of pyrazole ring), 6.79 (s, 1H, at C_3 of benzofuron ring), 8.62 (s, 1H, at C_4 of quinoline ring), 2.33 (s, 1H, CH_3), 8.94 (s, 1H, of C<u>H</u>=N thiadiazepines ring), 7.01-7.67 (m, 12H, Ar-H + heteroaryl), ^{13}C NMR δ ppm (DMSO-d_6): 17.12, 106.51, 111.13, 118.11, 121.76, 122.31, 123.54, 125.11, 123.84, 125.73, 125.81, 127.38, 128.90, 129.48, 129.78, 134.68, 135.60, 136.73, 138.91, 139.48, 142.81, 144.02, 153.89, 155.59, 161.85, 177.22, 189.56. Elemental analysis (%) for $C_{30}H_{19}N_7OS$ calculated: C, 68.56; H, 3.64; N, 18.65; S, 6.10 Found: C, 68.52; H, 3.73; N, 18.63; S, 6.02; ESI-MS (*m/z)* : 526 $[M+H]^+$, 548 $[M+Na]^+$.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-10-methylquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7b): Colour: Yellow, m.p.: 180 °C, Yield: 82 %, R_f: 0.63. IR (KBr, ν_{max}, cm^{-1}): 3063 (C-H str., Ar-H), 2922 (C-H asym. str.), 2815 (C-H sym.str.), 1420 (C-H i.p. def.), 1375 (C-H o.o.p. def.), 1492, 1518, 1568, 1612 (C=C str. aromatic), 1072 (C-H i.p. def., Ar.), 805, 850 (C-H o.o.p. def., Ar.), 1615, 1569 (C=N str., triazole), 1225 (C-N str., triazole), 1003 (N-N str.), 690, 715 (C-S-C str., thiadiazepines ring), 1259 (C-O-C sym. str.), 1075 (C-O-C asym. str.). Elemental analysis (%) for $C_{30}H_{19}N_7OS$ calculated: C, 68.56; H, 3.64; N, 18.65; O, 3.04; S, 6.10 Found: C, 68.57; H, 3.68; N, 18.59; O, 3.04; S, 5.98.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-9-methylquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7c): Colour: Yellow, m.p.: 182 °C, Yield: 82 %, R_f: 0.72. IR (KBr, ν_{max}, cm^{-1}): 3069 (C-H str. Ar-H), 2930 (C-H asy. str.), 2815 (C-H-sym. str.), 1492 (C-H i.p. def.), 1375 (C-H o.o.p. def.), 1492, 1515, 1562, 1611 (C=C *str*., Ar.), 1072 (C-H i.p. def., Ar.), 805, 845 (C-H o.o.p. def., Ar.), 1616, 1567 (C=N str., triazole), 1225 (C-N str., triazole), 1005 (N-N str.), 695, 715 (C-S-C str., thiadiazepines ring), 1259 (C-O-C sym. str.), 1075 (C-O-C asym. str). Elemental analysis (%) for $C_{30}H_{19}N_7OS$ calculated: C, 68.56; H, 3.64; N, 18.65; O, 3.04; S, 6.10; Found: C, 68.59; H, 3.65; N, 18.68; O, 3.04; S, 6.05.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-9-bromoquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7d): Colour: Yellow-orange, m.p.: 187 °C, Yield: 87 %, R_f: 0.70. IR (KBr, ν_{max}, cm^{-1}): 3065 (C-H str. Ar-H), 2935 (C-H asy. str.), 2813 (C-H sym. str.), 1495 (C-H i.p. def.), 1377 (C-H o.o.p. def.), 1495, 1511, 1564, 1613 (C=C str., Ar.), 1076 (C-H i.p. def. Ar.), 806, 842 (C-H Ar. o.o.p. def. Ar.), 1612, 1565 (C=N str., triazole), 1222 (C-N str., triazole), 1002 (N-N str.), 693, 712 (C-S-C str., thiadiazepines ring), 1258 (C-O-C sym. str.), 1076 (C-O-C asym. str). Elemental analysis (%) for $C_{29}H_{16}N_7OSBr$ calculated: C, 58.99; H, 2.73; N, 16.61; S, 5.43 Found: C, 59.09; H, 2.76; N, 16.71; S, 5.43.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-10-chloroquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7e): Colour: yellow, m.p.: 185 °C, Yield: 79 %, R_f: 0.68. IR (KBr, ν_{max}, cm^{-1}): 3060 (C-H str. Ar-H), 2931 (C-H asy. str.), 2818 (C-H sym. str.), 1493 (C-H i.p. def.), 1378 (C-H o.o.p. def.), 1490, 1516, 1565, 1619 (C=C str., Ar.), 1072

(C-H i.p. def., Ar.), 804, 840 (C-H o.o.p. def., Ar.), 1615, 1563 (C=N str., triazole), 1225 (C-N str., triazole), 1003 (N-N str.), 695, 715 (C-S-C str., thiadiazepines ring), 1260 (C-O-C sym. str.), 1072 (C-O-C asym. str). Elemental analysis (%) for $C_{29}H_{16}N_7OSCl$ calculated: C, 63.79; H, 2.95; N, 17.96; S, 5.87 Found: C, 63.73; H, 2.98; N, 17.91; S, 5.78.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-9-chloroquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7f): Colour: yellow, m.p.: 179 °C, Yield: 82 %, R_f: 0.65. IR (KBr, ν_{max}, cm^{-1}): 3067 (C-H str. Ar-H), 2933 (C-H asy. str.), 2819 (C-H-sym. str.), 1496 (C-H i.p. def.), 1377 (C-H o.o.p. def.), 1493, 1517, 1562, 1619 (C=C str., Ar.), 1075 (C-H i.p. def., Ar.), 805, 840 (C-H Ar. o.o.p. def., Ar.), 1613, 1563 (C=N str., triazole), 1226 (C-N str., triazole), 1005 (N-N str.), 692, 715 (C-S-C str., thiadiazepines ring), 1262 (C-O-C sym. str.), 1075 (C-O-C asym. str). Elemental analysis (%) for $C_{29}H_{16}N_7OSBr$ calculated: C, 58.99; H, 2.73; N, 16.61; S, 5.43 Found: C, 59.74; H, 2.69; N, 16.60; S, 5.42.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-11-methoxyquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7g): Colour: Yellow-brown, m.p.: 183 °C, Yield: 80 %, R_f: 0.67. IR (KBr, ν_{max}, cm^{-1}): 3063 (C-H str. Ar-H), 2935 (C-H asy. str.), 2820 (C-H-sym. str.), 1495 (C-H i.p. def.), 1375 (C-H o.o.p. def.), 1495, 1518, 1565, 1620 (C=C str., Ar.), 1072 (C-H i.p. def., Ar.), 802, 842 (C-H o.o.p. def., Ar.), 1615, 1565 (C=N str., triazole), 1225 (C-N str., triazole), 1006 (N-N str.), 693, 712 (C-S-C str., thiadiazepines ring), 1265 (C-O-C sym. str.), 1077 (C-O-C asym. str.). Elemental analysis (%) for $C_{30}H_{19}N_7O_2S$ calculated: C, 66.53; H, 3.54; N, 18.10; S, 5.92 Found: C, 66.57; H, 3.60; N, 18.05; S, 5.88.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-9-methoxyquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]-thiadiazepine (7h): Colour: Yellow-brown, m.p.: 184 °C, Yield: 78 %, R_f: 0.65. IR (KBr, ν_{max}, cm^{-1}): 3062 (C-H str. Ar-H), 2937 (C-H asy. str.), 2822 (C-H-sym. str.), 1498 (C-H i.p. def), 1377 (C-H o.o.p. def.), 1491, 1516, 1563, 1620 (C=C str. Ar.), 1077 (C-H i.p. def.), 805, 848 (C-H Ar. o.o.p. def.), 1615, 1568 (C=N str., triazole), 1225 (C-N str., triazole), 1008 (N-N str.), 699, 715 (C-S-C str., thiadiazepines ring), 1267 (C-O-C sym. str.), 1078 (C-O-C asym. str). Elemental analysis (%) for $C_{30}H_{19}N_7O_2S$ calculated: C, 66.53; H, 3.54; N, 18.10; S, 5.92 Found: C, 66.52; H, 3.51; N, 18.12; S, 5.98.

3-[5-(Benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-9-ethoxyquinolino[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazepine (7i): Colour: Yellow-brown, m.p.: 190 °C, Yield: 85 %, R_f: 0.68. IR (KBr, ν_{max}, cm^{-1}): 3061 (C-H str. Ar-H), 2939 (C-H asym. str.), 2823 (C-H sym. str.), 1495 (C-H i.p. def), 1375 (C-H o.o.p. def.), 1490, 1513, 1565, 1624 (C=C str., Ar.), 1074 (C-H i.p. def.), 806, 848 (C-H Ar. o.o.p. def.), 1615, 1568 (C=N str. in triazole), 1229 (C-N str. triazole), 1002 (N-N str.), 700, 716 (C-S-C str., thiadiazepines ring), 1269 (C-O-C sym. str.), 1079 (C-O-C asym. str).Elemental analysis (%) for $C_{31}H_{21}N_7O_2S$ calculated: C, 67.01; H, 3.81; N, 17.65; O, 5.76; S, 5.77; Found: C, 67.12; H, 3.71; N, 17.57; S, 5.74.

Antibacterial activity: All the novel synthesized compounds (**7a-i**) were screened for *in vitro* antimicrobial activity against Gram-positive bacteria *S. aureus* and Gram-negative strains, *P. vulgaris*, *E. coli* and *S. typhi* by following disc-diffusion method. Petri plates were prepared by pouring 10 mL of Mueller Hinton Agar and was allowed to solidify. The micro-organism culture were inoculated in fresh 10 mL fresh nutrient broth to yield an initial suspension and maintained in nutrient agar medium. Standard inoculums were introduced onto the surface of sterile agar plates and a sterile glass spreader was used for for distribution of the inoculums. The discs measuring 6 mm in diameter were prepared from Whatmann No.1 filter paper and sterilized by dry heat at 140 °C for 1h. Test solution was prepared by dissolving known weight of each compound (**7a-i**) in dimethyl sulphoxide as solvent and diluted suitably to give the resultant concentration of 31-1000 µg/mL. The sterile discs previously soaked in a known concentration of the test compounds were placed in the nutrient agar medium and the inhibition zone was measured in mm as diameter in four directions and expressed as mean. The results were compared using chloramphenicol as a standard antibacterial agent. The zone of inhibition data are presented in Table-1.

RESULTS AND DISCUSSION

Synthesis of 3-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-substituted quinoline[3,2-*f*][1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazepine (**7a-i**) has been carried out by cyclo-condensation of 5-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-4-amino-4*H*-1,2,4-triazole-3-thiol (**4**) [34] with 2-chloro-quinoline-3-carbaldehyde derivatives (**6a-i**) in presence of potassium carbonate in DMF as solvent. The physical constants like melting point and solubility were determined for all the intermediate and final products. At every stage the reaction is monitored with TLC. Newly synthesized compound have been characterized on the basis of elemental analysis as well as by FT-IR, ^{1}H NMR, ^{13}C NMR and mass spectra and they also screened for antimicrobial activities.

IR spectra of compounds (**7a-i**) shows sharp stretching absorption bands at 693-718 cm^{-1} due to C-S-C stretch in thiadiazepine and bands at 1612, 1565 cm^{-1} for C=N stretching in thiadiazepine and triazoles ring which confirms cyclization to form thiadiazepine ring. Absorption band at 1000 cm^{-1} shows N-N str. in both the rings.

^{1}H NMR of **7a** revealed a singlet at δ 8.94 ppm due to one proton of CH=N in thiadiazepines ring, another singlet at δ 8.62 ppm supported the presence of one proton attached to C_4 of quinoline ring, yet another singlet at δ 6.52 shows a proton attached to C_4 of pyrazole ring. Multiplet signals in the range 7.01-7.67 ppm due to twelve aromatic protons including benzofuran ring and a singlet at δ 2.33 ppm for three protons, of -CH_3 in quinoline ring were also observed. ^{13}C NMR also supported data singlet signal at δ17.12 ppm revealed one aliphatic carbon of -CH_3 attached to quinoline ring, δ189.56 ppm C_2 of quinoline ring adjacent to sulphur of thiadiazepines ring, δ 177.22 ppm confirm C_5 of pyrazole ring neighbouring to sulphur of thiadiazpenies. Elemental analysis obtained was in good agreement with calculated value. The percentage of C, H, N and S were found to be 68.52, 3.73, 18.63 and 6.02, respectively. The mass spectrum of product reveals a molecular ion peak at 526 $[M+H]^+$ and 548 $[M+Na]^+$ is in reliable with the molecular formula $C_{30}H_{19}N_7OS$ for **7a**. All above spectral data favours confirmation of synthesized compound.

TABLE-1
ANTIBACTERIAL ACTIVITY OF 3-[5-(BENZOFURAN-2-YL)-1-PHENYL-1*H*-PYRAZOL-3-YL]-SUBSTITUTED QUINOLINO[3,2-*f*][1,2,4]TRIAZOLO[3,4-*b*][1,3,4]THIADIAZEPINES (**7a-f**)

Compd. code	Zone of inhibition (mm)											
	Gram-positive [*S. aureus*, Conc. (µg/mL)]						Gram-negative [*P. vulgaris*, Conc. (µg/mL)]					
	1000	500	250	125	63.5	31	1000	500	250	125	63.5	31
7a	24	21	22	18	16	19	29	23	20	19	16	13
7b	21	20	19	15	14	17	25	26	19	16	15	12
7c	24	23	18	16	17	19	23	20	18	17	15	16
7d	23	22	21	15	18	15	23	23	20	19	18	12
7e	17	17	15	14	13	14	22	19	14	13	13	11
7f	14	16	13	12	13	14	26	20	16	11	12	10
DMSO	–	–	–	–	–	–	–	–	–	–	–	–
Chloramphenicol	24	22	20	19	16	17	28	24	20	17	16	13
	Gram-negative [*E. coli*, Conc. (µg/mL)]						Gram-negative [*S. typhi*, Conc. (µg/mL)]					
	1000	500	250	125	63.5	31	1000	500	250	125	63.5	31
7a	27	25	23	21	19	13	18	16	09	09	10	08
7b	23	21	22	20	16	16	16	10	08	06	08	07
7c	27	20	24	16	15	15	18	15	13	11	09	08
7d	26	18	20	22	18	13	10	08	12	08	08	07
7e	21	19	18	17	14	14	09	06	08	13	07	06
7f	17	16	17	15	16	10	08	05	06	06	05	05
DMSO	–	–	–	–	–	–	–	–	–	–	–	–
Chloramphenicol	26	24	23	21	17	14	17	15	12	11	09	08

Antibacterial activity: The antibacterial activity of the newly synthesized compounds **7a-i** were reported as zone of inhibition at the concentration range, 31-1000 µg/mL against *S. aureus*, (Gram-positive bacteria) and *E. coli*, *P. vulgaris*, *S. typhi* (Gram-negative bacteria) using Chloramphenicol as standard and the results are summarized in Table-1. Compounds **7a, 7c** and **7d** showed comparatively excellent activity against *E. coli*, *P.vulgaris*, *S. aureus* while at rest of concentrations remaining compounds showed moderate to good activity against *P. vulgaris* and *E. coli* respectively. While some of the compounds have been found to possess poor activity against *S. typhi* and some of the concentrations for selected strains of bacteria.

Conclusion

In this study, 1,3,4-thiadiazepines derivatives (**7a-i**) were synthesized by economic, better yield and safer methods through cyclocondensation of 5-[5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazol-3-yl]-4-amino-4*H*-1,2,4-triazole-3-thiol (**4**) with 2-chloro-quinoline-3-carbaldehyde derivatives (**6a-i**) in DMF as a solvent. Their purity and confirmation were established by physical, analytical and spectral data. The compounds **7a-f** were investigated for their antimicrobial screening and observed that these compounds were found to posses excellent to moderate activity against selected strains of bacteria.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

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