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Synthesis and Antimicrobial Activity of 3-(1,3,4-Oxadiazol-2-yl)quinazolin-4(3H)-ones

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Abstract

In attempt to find new pharmacologically active molecules, we report here the synthesis and *in vitro* antimicrobial activity of various 3-(1,3,4-oxadiazol-2-yl)-quinazolin-4(3H)-ones. The antimicrobial activity of title compounds were examined against two gram positive bacteria (*S. aureus*, *S. pyogenes*), two gram negative bacteria (*E. coli*, *P. aeruginosa*) and three fungi (*C. albicans*, *A. niger*, *A. clavatus*) using the broth microdilution method. Some derivatives bearing a bromo or iodo group exhibited very good antimicrobial activity.

Keywords

Antimicrobial activity • 1,3,4-Oxadiazole • Quinazolin-4(3H)-one

Introduction

The chemistry of heterocyclic compounds has been an interesting field of study for a long time. The synthesis of novel oxadiazole derivatives and investigation of their chemical and biological behavior have gained more importance in recent decades for biological, medicinal and agricultural reasons. 1,3,4-Oxadiazoles represent an important class of heterocyclic compounds. Their derivatives possess a broad spectrum of biological activity in both agrochemicals and pharmaceuticals such as insecticidal, herbicidal, antibacterial, antifungal, analgesic, anti-inflammatory, antimalarial, antiviral, anti-HBV, antianxiety, anticancer, anti-HIV, antitubercular and anticonvulsant [1–14]. Quinazolinone nucleus has been gaining prominence due to the fact that its derivatives have been found to possess wide spectrum of pharmacological properties. Quinazolin-4(3H)-one derivatives are useful heterocycles, possessing potent pharmacological activities such as antibacterial, antifungal, analgesic, anti-inflammatory, anthelmintic, anticancer, anticonvulsant,

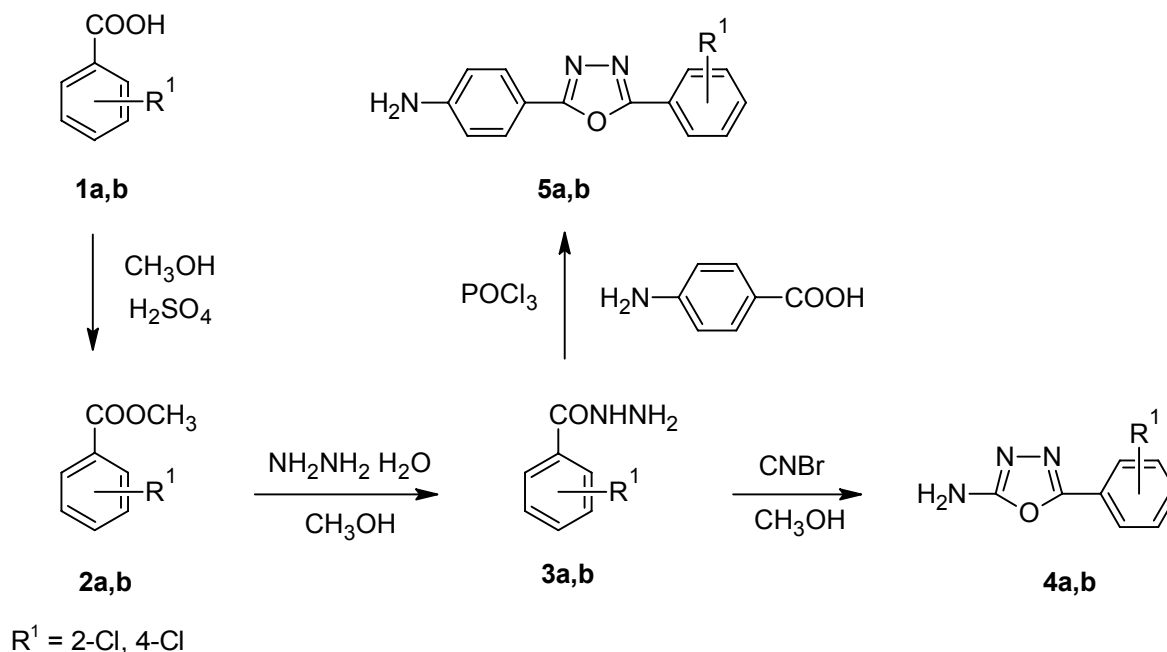
antihistaminic, anti-HIV, antiproliferative, antitubercular, antiviral, CNS depressant, cytotoxicity, diuretic and hypolipidemic [15–30].

1,3,4-Oxadiazoles and quinazolin-4(3*H*)-ones having various heterocycles possess wide range of pharmacological properties. The aim of the present work was to attach 1,3,4-oxadiazole residues to quinazolin-4(3*H*)-one in order to find new biologically active molecules. Thus, the synthesis of novel 1,3,4-oxadiazolyl-quinazolin-4(3*H*)-one derivatives has been achieved.

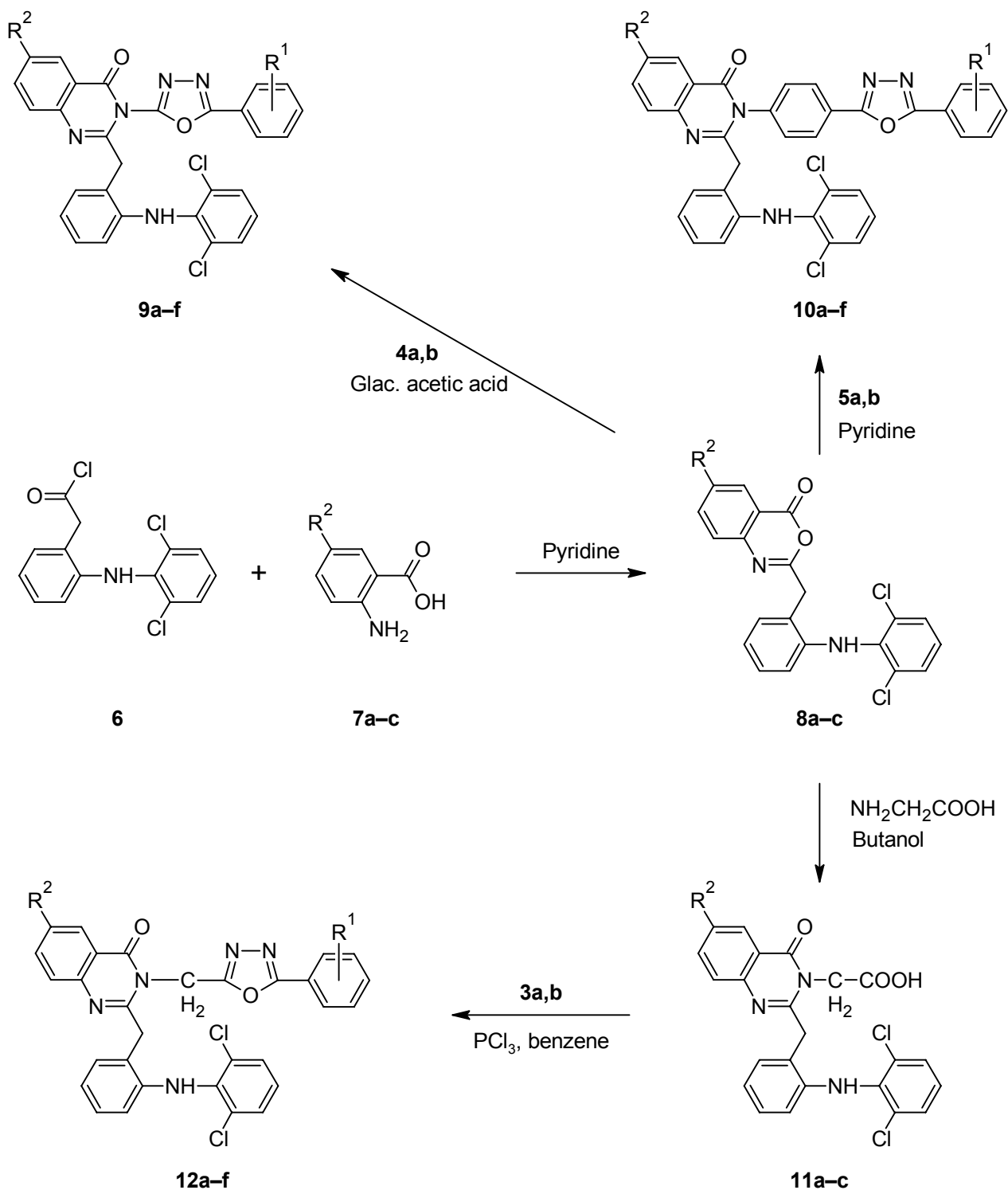
Results and Discussion

Chemistry

The title compounds **9a–f**, **10a–f** and **12a–f** were synthesized according to Scheme 2. The structure of all the synthesized compounds were evaluated by spectral data. Benzoic acid derivatives **1a,b** were converted into esters **2a,b** using methanol and catalytic amount of sulphuric acid. Esters **2a,b** on treatment with hydrazine hydrate yielded corresponding hydrazides **3a,b**. The IR spectra of **3a,b** showed the absence of ester stretching frequency, instead in gave a band at around 1650 cm^{-1} for carbonyl group and showing sharp bands in the region of $3300\text{--}3435\text{ cm}^{-1}$ due to -NHNH_2 group. Hydrazides on cyclization reaction with methanolic cyanogen bromide and 4-aminobenzoic acid in phosphorus oxychloride yielded amino substituted 1,3,4-oxadiazoles **4a,b** and **5a,b** respectively (Scheme 1). 1,3,4-oxadiazole showed $\text{C}=\text{N}$ stretching at around 1655 cm^{-1} and C-O-C stretching at around 1270 cm^{-1} and 1040 cm^{-1} . Signals at around $158\text{ }\delta\text{ ppm}$ and $164\text{ }\delta\text{ ppm}$ confirmed the C-2 and C-5 carbon of 1,3,4-oxadiazole unite.



Sch. 1.



Sch. 2.

Substituted benzoxazinones **8a–c** were prepared by reaction of acid chloride **6** with substituted anthranilic acid **7a–c** in pyridine. Then condensation reaction of **8a–c** with 1,3,4-oxadiazoles **4a,b** and **5a,b** yielded the desired compounds **9a–f** and **10a–f**. Substituted benzoxazinones **8a–c** on reaction with glycine yielded quinazolin-4(3*H*)-ones **11a–c** which on cyclization reaction with hydrazides **3a,b** gave the desired compounds **12a–f** (Scheme 2). IR spectra showed C=O and C=N stretching frequencies of quinazolinone at around 1680 cm⁻¹ and 1610 cm⁻¹ respectively, further confirmed by ¹³C NMR spectra, which showed C=O and C=N signal at around 160.5 δ ppm and 163.5 δ ppm respectively.

Antibacterial activity

Tab. 1. Antibacterial activity (MBC, µg/ml) of compounds **4a,b**, **5a,b**, **9a–f**, **10a–f** and **12a–f**.

Comp.	R ¹	R ²	Gram positive bacteria		Gram negative bacteria	
			<i>S. aureus</i> MTCC 96	<i>S. pyogenes</i> MTCC 442	<i>E. coli</i> MTCC 443	<i>P. aeruginosa</i> MTCC 1688
4a	2-Cl	–	250	250	50	250
4b	4-Cl	–	200	250	250	500
5a	2-Cl	–	100	150	250	200
5b	4-Cl	–	200	250	500	500
9a	2-Cl	H	250	200	500	500
9b	2-Cl	Br	100	250	200	250
9c	2-Cl	I	500	500	100	250
9d	4-Cl	H	200	250	200	250
9e	4-Cl	Br	250	250	250	150
9f	4-Cl	I	500	1000	250	200
10a	2-Cl	H	150	250	500	500
10b	2-Cl	Br	500	1000	250	500
10c	2-Cl	I	100	150	150	500
10d	4-Cl	H	500	500	200	250
10e	4-Cl	Br	250	250	150	250
10f	4-Cl	I	62.5	150	100	250
12a	2-Cl	H	500	500	250	250
12b	2-Cl	Br	500	500	100	50
12c	2-Cl	I	50	250	125	200
12d	4-Cl	H	500	500	150	200
12e	4-Cl	Br	500	250	100	250
12f	4-Cl	I	200	200	50	150
Ampicillin	–	–	250	100	100	100

The minimal bactericidal concentrations of the tested compounds are shown in Tab. 1. The three different series of 1,3,4-oxadiazolyl-quinazolin-4(3*H*)-ones **9a–f**, **10a–f** and **12a–f** were tested for *in vitro* antibacterial activity against two gram positive bacteria (*S. aureus* MTCC 96, *S. pyogenes* MTCC 442) and two gram negative bacteria (*E. coli* MTCC 443, *P. aeruginosa* MTCC 1688). Ampicillin was used as a standard drug. Results showed that,

most of the compounds possessed very good antibacterial activity (MBC = 50-250 µg/ml) against gram positive bacteria *S. aureus*. Some of the compounds possessed excellent activity as compared to ampicillin. Compounds **5a**, **9b**, **10a**, **10c**, **10f** and **12c** showed MBC value in the range between 50–150 µg/ml while standard drug ampicillin itself had MBC value of 250 µg/ml against gram positive bacteria *S. aureus*. Compounds **4a**, **4b**, **5b**, **9a**, **9d**, **9e**, **10e** and **12f** imparted parallel activity as ampicillin with MBC in the range 200-250 µg/ml. **5a**, **10c** and **10f** have MBC at 150 µg/ml which were comparatively good as ampicillin against *S. pyogenes*. **4a** and **12f** showed excellent activity at 50 µg/ml while **9c**, **10f**, **12b** and **12e** possessed good activity at 100 µg/ml against gram negative bacteria *E. coli* as compared to ampicillin. Compound **12b** showed excellent activity at 50 µg/ml, while **9e** and **12f** exhibited good activity at 150 µg/ml against *P. aeruginosa*. The remaining compounds of the three different series possessed moderate to poor activities.

Antifungal activity

Tab. 2. Antifungal activity (MFC, µg/ml) of compds. **4a,b**, **5a,b**, **9a–f**, **10a–f** and **12a–f**.

Comp.	R ¹	R ²	Fungal species		
			<i>C. albicans</i> MTCC 227	<i>A. niger</i> MTCC 282	<i>A. clavatus</i> MTCC 1323
4a	2-Cl	–	250	1000	1000
4b	4-Cl	–	>1000	>1000	>1000
5a	2-Cl	–	500	500	500
5b	4-Cl	–	500	>1000	>1000
9a	2-Cl	H	500	250	250
9b	2-Cl	Br	500	500	500
9c	2-Cl	I	500	500	>1000
9d	4-Cl	H	500	250	250
9e	4-Cl	Br	500	500	500
9f	4-Cl	I	250	200	200
10a	2-Cl	H	>1000	>1000	>1000
10b	2-Cl	Br	250	500	>1000
10c	2-Cl	I	>1000	>1000	>1000
10d	4-Cl	H	500	>1000	>1000
10e	4-Cl	Br	500	>1000	>1000
10f	4-Cl	I	250	500	500
12a	2-Cl	H	>1000	500	>1000
12b	2-Cl	Br	250	500	250
12c	2-Cl	I	100	200	200
12d	4-Cl	H	>1000	>1000	>1000
12e	4-Cl	Br	500	>1000	500
12f	4-Cl	I	200	>1000	500
Griseofulvin	–	–	500	100	100

Minimal fungicidal concentrations of the synthesized compounds are shown in Table 2. For *in vitro* antifungal activity, three fungal species *C. albicans* MTCC 227, *A. niger* MTCC 282 and *A. clavatus* MTCC 1323 were used and compared with standard drug griseofulvin. Most of the compounds possessed very good antifungal activity against *C. albicans*. Their

MFC values are in the range between 100-500 µg/ml. Compound **12c** showed excellent activity at 100 µg/ml whereas compounds **4a**, **9f**, **10b**, **10f**, **12b** and **12f** possessed very good activity at 200-250 µg/ml while **5a,b**, **9a-e**, **10d,e** and **12e** share similar activities as griseofulvin which was 500 µg/ml against *C. albicans*. Compounds **9a**, **9d**, **9f** and **12c** showed moderate activities with MFC of 200-250 µg/ml against *A. niger* and *A. clavatus*. The remaining compounds displayed poor activities against both fungal species *A. niger* and *A. clavatus* as compared to control drug griseofulvin.

Experimental

Chemistry

All chemical were of analytical grade and used directly. Melting points were determined in PMP-DM scientific melting point apparatus and are uncorrected. IR spectra were recorded on a Perkin-Elmer RX 1 FTIR spectrophotometer, using potassium bromide pellets and the frequencies are expressed in cm^{-1} . The ^1H NMR and ^{13}C NMR spectra were recorded with a Bruker Avance II 400 NMR spectrometer, using tetramethylsilane as the internal reference, with dimethylsulphoxide DMSO- d_6 as solvent. The chemical shifts are reported in parts per million (ppm). Elemental analyses were performed on a Heraeus Carlo Erba 1180 CHN analyzer. The purity of compounds was confirmed by TLC using Merck silica gel 60 F254 plates using toluene:ethylacetate:methanol (7:2:1) as a mobile phase and spots were visualized under UV radiation. {2-[(2,6-Dichlorophenyl)amino]phenyl}acetyl chloride (**6**) was synthesized by the literature procedure [31].

General procedure for esters (2a,b)

Substituted benzoic acid **1a,b** (20 mmol) and 30 ml methanol was refluxed on water bath for 5–8 h in a few drops of concentrated sulfuric acid as a catalyst. After completion of the reaction, it was poured onto ice cold water. The obtained solid was washed with sodium bicarbonate solution (5%), dried and recrystallized twice from methanol.

Methyl 2-chlorobenzoate (2a)

Yield: 75%, bp: 232–236°C. IR (KBr), ν , cm^{-1} : 740 (C-Cl), 2856, 2960 (CH_3), 1286, 1121 (C-O-C), 1722 (C=O).

Methyl 4-chlorobenzoate (2b)

Yield: 72%, mp: 40–45°C. IR (KBr), ν , cm^{-1} : 742 (C-Cl), 2852, 2959 (CH_3), 1282, 1119 (C-O-C), 1720 (C=O).

General procedure for hydrazides (3a,b)

To a solution of methyl benzoates **2a,b** (10 mmol) in 15 ml methanol was added hydrazine hydrate (20 mmol). The reaction mixture was refluxed on a water bath for 8–10 h and allowed to stand overnight. The crystals formed were filtered, washed and after drying recrystallized from methanol.

2-Chlorobenzohydrazide (3a)

Yield: 70%, mp: 112–116°C. IR (KBr), ν , cm^{-1} : 742 (C-Cl), 1650 (C=O), 3308 (NH), 3429, 3348 (NH_2).

4-Chlorobenzohydrazide (3b)

Yield: 67%, mp: 163–166°C. IR (KBr), ν , cm^{-1} : 745 (C-Cl), 1645 (C=O), 3310 (NH), 3433, 3352 (NH_2).

General procedure for 5-substituted phenyl-1,3,4-oxadiazol-2-amines (4a,b)

To the 10 ml methanolic solution of substituted benzohydrazides **3a,b** (5 mmol), cyanogen bromide (7.5 mmol) was added. The reaction mixture was refluxed on water bath for 5–7 h. The resulting solution was cooled and neutralized with sodium bicarbonate solution (5% w/v). The solid thus separated out was filtered, washed with water, dried and recrystallized from methanol.

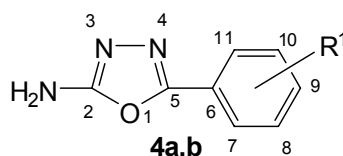


Fig. 1. Numbering of 5-substituted phenyl-1,3,4-oxadiazol-2-amines **4a,b**

5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-amine (4a)

Yield: 62%, mp: 165–168°C, lit. 164–166°C [32]. IR (KBr), ν , cm^{-1} : 742 (C-Cl), 1265, 1036 (C-O-C), 1649 (C=N), 3470, 3402 (NH_2). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 7.35 (bs, 2H, NH_2), 7.49 (t, $J = 7.52$ Hz, 1H, H-9), 7.55 (t, $J = 7.36$ Hz, 1H, H-10), 7.65 (d, $J = 7.8$ Hz, 1H, H-8), 7.70 (d, $J = 7.48$ Hz, 1H, H-11). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 127.53 (C-10), 128.12 (C-11), 128.69 (C-8), 129.81 (C-9), 131.43 (C-7), 135.18 (C-6), 157.53 (C-2), 163.50 (C-5). Anal. Calcd. for $\text{C}_8\text{H}_6\text{N}_3\text{OCl}$: C, 49.12; H, 3.09; N, 21.48. Found: C, 49.25; H, 3.14; N, 21.41.

5-(4-Chlorophenyl)-1,3,4-oxadiazol-2-amine (4b)

Yield: 70%, mp: 243–245°C, lit. 231–233°C [32]. IR (KBr), ν , cm^{-1} : 745 (C-Cl), 1277, 1043 (C-O-C), 1662 (C=N), 3480, 3396 (NH_2). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 7.37 (bs, 2H, NH_2), 7.62 (d, $J = 8.24$ Hz, 2H, H-8,10), 7.69 (d, $J = 8.24$ Hz, 2H, H-7,11). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 123.34 (C-6), 131.78 (C-7,11), 133.20 (8,10), 135.42 (C-9), 157.58 (C-2), 163.56 (C-5). Anal. Calcd. for $\text{C}_8\text{H}_6\text{N}_3\text{OCl}$: C, 49.12; H, 3.09; N, 21.48. Found: C, 48.98; H, 3.17; N, 21.56.

General procedure for 4-(5-substitutedphenyl-1,3,4-oxadiazol-2-yl)benzenamines (5a,b)

A mixture of 4-aminobenzoic acid (5 mmol) and substituted benzohydrazides **3a,b** (5 mmol) in 5 ml phosphorus oxychloride was refluxed on water bath for 7–10 h. After the completion of reaction, it was cooled and poured onto crushed ice with continuous stirring. The solid mass separated was neutralized with sodium bicarbonate solution (10% w/v). The resulting solid thus obtained was collected by filtration, washed well with cold water, dried and recrystallized from absolute ethanol.

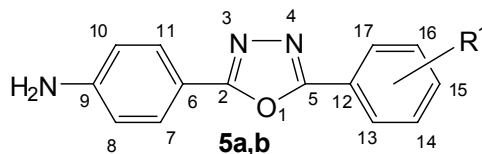


Fig. 2. Numbering of 4-(5-substituted phenyl-1,3,4-oxadiazol-2-yl)benzenamines **5a,b**

4-[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]benzenamine (5a)

Yield: 63%, mp: 175–178°C. IR (KBr), ν , cm^{-1} : 746 (C-Cl), 1266, 1042 (C-O-C), 1653 (C=N), 3482, 3380 (NH_2). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 5.46 (bs, 2H, NH_2), 6.80 (d, $J = 8.32$ Hz, 2H, H-8,10), 7.31 (d, $J = 8.32$ Hz, 2H, H-7,11), 7.50 (t, $J = 7.56$ Hz, 1H, H-15), 7.56 (t, $J = 7.4$ Hz, 1H, H-16), 7.64 (d, $J = 7.84$ Hz, 1H, H-14), 7.68 (d, $J = 7.5$ Hz, 1H, H-17). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 108.13 (C-6), 114.84 (C-8,10), 127.53 (C-16), 128.14 (C-17), 128.62 (C-7,11), 128.74 (C-14), 129.85 (C-15), 131.38 (C-13), 135.22 (C-12), 148.48 (C-9), 162.37 (C-2,5). Anal. Calcd. for $\text{C}_{14}\text{H}_{10}\text{N}_3\text{OCl}$: C, 61.89; H, 3.71; N, 15.47. Found: C, 61.76; H, 3.75; N, 15.39.

4-[5-(4-Chlorophenyl)-1,3,4-oxadiazol-2-yl]benzenamine (5b)

Yield: 65%, mp: 210–214°C, lit. 210–212°C [12]. IR (KBr), ν , cm^{-1} : 743 (C-Cl), 1268, 1040 (C-O-C), 1658 (C=N), 3482, 3375 (NH_2). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 5.45 (bs, 2H, NH_2), 6.79 (d, $J = 8.36$ Hz, 2H, H-8,10), 7.29 (d, $J = 8.36$ Hz, 2H, H-7,11), 7.63 (d, $J = 8.2$ Hz, 2H, H-14,16), 7.68 (d, $J = 8.2$ Hz, 2H, H-13,17). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 107.42 (C-6), 114.45 (C-8,10), 123.31 (C-12), 128.73 (C-7,11), 131.82 (C-13,17), 133.24 (C-14,16), 135.44 (C-15), 148.53 (C-9), 161.89 (C-2,5). Anal. Calcd. for $\text{C}_{14}\text{H}_{10}\text{N}_3\text{OCl}$: C, 61.89; H, 3.71; N, 15.47. Found: C, 61.78; H, 3.66; N, 15.54.

General procedure for benzoxazinones (8a–c)

A mixture of {2-[(2,6-Dichlorophenyl)amino]phenyl}acetyl chloride (**6**) (10 mmol) and substituted anthranilic acids **7a–c** (10 mmol) in 20 ml pyridine were stirred at 0–5°C for 1 h, further stirred for 1 h at room temperature. After completion of reaction, a pasty mass obtained, was washed thoroughly with sodium bicarbonate (5 % w/v) to remove unreacted acid. A solid separated was filtered, dried and recrystallized from methanol.

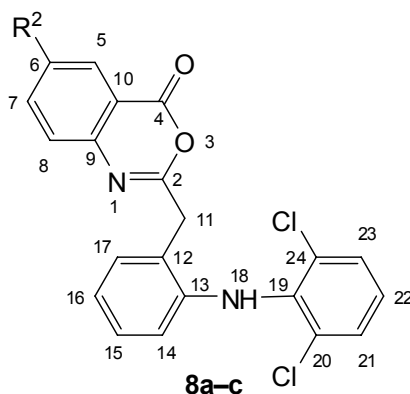


Fig. 3. Numbering of Benzoxazinones **8a–c**

2-[2-(2,6-Dichlorophenyl)amino]benzyl-4H-3,1-benzoxazin-4-one (8aF)

Yield: 53%, mp: 183–186°C, lit. 185–187 °C [33]. IR (KBr), v, cm⁻¹: 745 (C-Cl), 1151 (C-O), 1316 (C-N), 1620 (C=N), 1742 (C=O), 2925, 2851 (CH₂), 3449 (NH). ¹H NMR (400 MHz, DMSO-*d*₆, TMS): δ 3.52 (s, 2H, H-11), 6.39 (d, *J* = 7.96 Hz, 1H, H-14), 6.88 (t, *J* = 7.4 Hz, 1H, H-16), 7.04-7.09 (m, 2H, H-15,22), 7.21 (d, *J* = 7.54 Hz, 1H, H-17), 7.42 (d, *J* = 8.08 Hz, 2H, H-21,23), 7.51 (d, *J* = 8.12 Hz, 1H, H-8), 7.84 (t, *J* = 7.8 Hz, 1H, H-7), 8.06 (t, *J* = 7.64 Hz, 1H, H-6), 8.12 (d, *J* = 7.72 Hz, 1H, H-5), 9.12 (bs, 1H, H-18). ¹³C NMR (100 MHz, DMSO-*d*₆, TMS): δ 32.47 (C-11), 116.27 (C-16), 116.54 (C-10), 120.54 (C-14), 122.35 (C-8), 124.15 (C-22), 126.61 (C-15), 127.12 (C-12), 127.32 (C-21,23), 127.54 (C-6), 129.34 (C-20,24), 131.23 (C-17), 131.52 (C-5), 135.43 (C-7), 137.23 (C-19), 141.76 (C-13), 149.53 (C-9), 159.36 (C-4), 164.51 (C-2). Anal. Calcd. for C₂₁H₁₄Cl₂N₂O₂: C, 63.49; H, 3.55; N, 7.05. Found: C, 63.45; H, 3.56; N, 7.03.

6-Bromo-2-[2-(2,6-dichlorophenyl)amino]benzyl-4H-3,1-benzoxazin-4-one (8b)

Yield: 55%, mp: 194–198°C, lit. 193–196 °C. [34]. IR (KBr), v, cm⁻¹: 565 (C-Br), 743 (C-Cl), 1153 (C-O), 1318 (C-N), 1618 (C=N), 1740 (C=O), 2926, 2850 (CH₂), 3446 (NH). ¹H NMR (400 MHz, DMSO-*d*₆, TMS): δ 3.53 (s, 2H, H-11), 6.40 (d, *J* = 8 Hz, 1H, H-14), 6.88 (t, *J* = 7.44 Hz, 1H, H-16), 7.03-7.08 (m, 2H, H-15,22), 7.22 (d, *J* = 7.58 Hz, 1H, H-17), 7.41 (d, *J* = 8.16 Hz, 2H, H-21,23), 7.65 (d, *J* = 8.32 Hz, 1H, H-8), 8.12 (d, *J* = 8.32 Hz, 1H, H-7), 8.16 (s, 1H, H-5), 9.10 (bs, 1H, H-18). ¹³C NMR (100 MHz, DMSO-*d*₆, TMS): δ 32.43 (C-11), 116.31 (C-16), 118.64 (C-10), 120.62 (C-14), 121.67 (C-6), 124.31 (C-22), 124.57 (C-8), 126.54 (C-15), 127.17 (C-12), 127.43 (C-21,23), 129.41 (C-20,24), 131.12 (C-17), 135.22 (C-5), 137.29 (C-19), 138.23 (C-7), 141.78 (C-13), 148.73 (C-9), 159.23 (C-4), 164.33 (C-2). Anal. Calcd. for C₂₁H₁₃BrCl₂N₂O₂: C, 52.97; H, 2.75; N, 5.88. Found: C, 52.94; H, 2.74; N, 5.90.

2-[2-(2,6-Dichlorophenyl)amino]benzyl-6-iodo-4H-3,1-benzoxazin-4-one (8c)

Yield: 58%, mp: 189–193°C. IR (KBr), v, cm⁻¹: 620 (C-I), 747 (C-Cl), 1148 (C-O), 1320 (C-N), 1617 (C=N), 1745 (C=O), 2923, 2848 (CH₂), 3450 (NH). ¹H NMR (400 MHz, DMSO-*d*₆, TMS): δ 3.53 (s, 2H, H-11), 6.41 (d, *J* = 7.92 Hz, 1H, H-14), 6.89 (t, *J* = 7.36 Hz, 1H, H-16), 7.04-7.09 (m, 2H, H-15,22), 7.22 (d, *J* = 7.54 Hz, 1H, H-17), 7.25 (d, *J* = 8.28 Hz, 1H, H-8), 7.42 (d, *J* = 8.12 Hz, 2H, H-21,23), 8.05 (d, *J* = 8.28 Hz, 1H, H-7), 8.48 (s, 1H, H-5), 9.10 (bs, 1H, H-18). ¹³C NMR (100 MHz, DMSO-*d*₆, TMS): δ 32.53 (C-11), 93.14 (C-6), 116.25 (C-16), 118.23 (C-10), 120.57 (C-14), 123.74 (C-8), 124.19 (C-22), 126.58 (C-15), 127.05 (C-12), 127.33 (C-21,23), 129.39 (C-20,24), 131.14 (C-17), 137.42 (C-19), 138.87 (C-5), 141.81 (C-13), 144.27 (C-7), 148.62 (C-9), 159.53 (C-4), 164.47 (C-2). Anal. Calcd. for C₂₁H₁₃Cl₂IN₂O₂: C, 48.21; H, 2.50; N, 5.35. Found: C, 48.25; H, 2.49; N, 5.33.

General procedure for 1,3,4-oxadiazoly-quinazolin-4(3H)-ones (9a–f)

A mixture of benzoxazinones **8a–c** (2.5 mmol) and 5-substituted phenyl-1,3,4-oxadiazol-2-amines **4a,b** (2.5 mmol) in 10 ml glacial acetic acid was refluxed under anhydrous condition for 4–6 h. After cooling it was poured into crushed ice. The solid separated out was filtered, thoroughly washed with cold distilled water, dried, and recrystallized from ethanol.

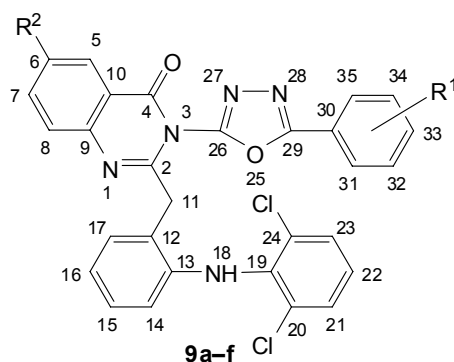


Fig. 4. Numbering of 1,3,4-Oxadiazolyl-quinazolin-4(3H)-ones **9a-f**

3-[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-quinazolin-4(3H)-one (9a**)**

Yield: 63%, mp: 233–235°C. IR (KBr), ν , cm^{-1} : 746 (C-Cl), 1318 (C-N), 1263, 1037 (C-O-C oxadiazole), 1609 (C=N quinazolinone), 1650 (C=N oxadiazole), 1678 (C=O quinazolinone), 2926, 2853 (CH_2), 3445 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.52 (s, 2H, H-11), 6.41 (d, $J = 7.96$ Hz, 1H, H-14), 6.89 (t, $J = 7.4$ Hz, 1H, H-16), 7.03-7.09 (m, 2H, H-15,22), 7.22 (d, $J = 7.54$ Hz, 1H, H-17), 7.41 (d, $J = 8.08$ Hz, 2H, H-21,23), 7.47 (t, $J = 7.68$ Hz, 1H, H-6), 7.50 (t, $J = 7.56$ Hz, 1H, H-33), 7.57 (t, $J = 7.4$ Hz, 1H, H-34), 7.61 (d, $J = 8.16$ Hz, 1H, H-8), 7.67 (d, $J = 7.84$ Hz, 1H, H-32), 7.71 (d, $J = 7.52$ Hz, 1H, H-35), 7.76 (t, $J = 7.84$ Hz, 1H, H-7), 8.10 (d, $J = 7.76$ Hz, 1H, H-5), 9.09 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.54 (C-11), 116.32 (C-16), 120.41 (C-14), 120.77 (C-10), 122.54 (C-8), 124.31 (C-22), 126.54 (C-15), 127.21 (C-12), 127.39 (C-21,23), 127.49 (C-34), 127.58 (C-6), 128.12 (C-35), 128.55 (C-32), 128.76 (C-5), 129.35 (C-20,24), 129.81 (C-33), 131.17 (C-17), 131.45 (C-31), 133.66 (C-7), 135.24 (C-30), 137.32 (C-19), 141.68 (C-13), 147.15 (C-9), 156.72 (C-26), 160.74 (C-4), 163.27 (C-2), 164.65 (C-29). Anal. Calcd. for $\text{C}_{29}\text{H}_{18}\text{Cl}_3\text{N}_5\text{O}_2$: C, 60.59; H, 3.16; N, 12.18. Found: C, 60.54; H, 3.11; N, 12.21.

6-Bromo-3-[5-(2-chlorophenyl)-1,3,4-oxadiazol-2-yl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (9b**)**

Yield: 55%, mp: 225–228°C. IR (KBr), ν , cm^{-1} : 570 (C-Br), 745 (C-Cl), 1311 (C-N), 1260, 1035 (C-O-C oxadiazole), 1611 (C=N quinazolinone), 1653 (C=N oxadiazole), 1675 (C=O quinazolinone), 2925, 2851 (CH_2), 3447 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.53 (s, 2H, H-11), 6.39 (d, $J = 8$ Hz, 1H, H-14), 6.89 (t, $J = 7.44$ Hz, 1H, H-16), 7.03-7.09 (m, 2H, H-15,22), 7.21 (d, $J = 7.58$ Hz, 1H, H-17), 7.42 (d, $J = 8.16$ Hz, 2H, H-21,23), 7.51 (t, $J = 7.52$ Hz, 1H, H-33), 7.55 (t, $J = 7.36$ Hz, 1H, H-34), 7.61 (d, $J = 8.24$ Hz, 1H, H-8), 7.66 (d, $J = 7.8$ Hz, 1H, H-32), 7.70 (d, $J = 7.48$ Hz, 1H, H-35), 8.08 (d, $J = 8.24$ Hz, 1H, H-7), 8.12 (s, 1H, H-5), 9.08 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.65 (C-11), 116.24 (C-16), 120.53 (C-14), 123.13 (C-10), 124.24 (C-22), 124.58 (C-8), 126.47 (C-15), 127.18 (C-12), 127.37 (C-21,23), 127.48 (C-34), 127.66 (C-6), 128.15 (C-35), 128.72 (C-32), 129.34 (C-20,24), 129.79 (C-33), 131.16 (C-17), 131.47 (C-31), 132.25 (C-5), 135.21 (C-30), 136.37 (C-7), 137.36 (C-19), 141.77 (C-13), 146.21 (C-9), 156.64 (C-26), 160.59 (C-4), 163.38 (C-2), 164.57 (C-29). Anal. Calcd. for $\text{C}_{29}\text{H}_{17}\text{BrCl}_3\text{N}_5\text{O}_2$: C, 53.28; H, 2.62; N, 10.71. Found: C, 53.19; H, 2.65; N, 10.75.

3-[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-6-iodoquinazolin-4(3H)-one (9c)

Yield: 66%, mp: 241–244°C. IR (KBr), ν , cm^{-1} : 618 (C-I), 740 (C-Cl), 1317 (C-N), 1262, 1042 (C-O-C oxadiazole), 1608 (C=N quinazolinone), 1655 (C=N oxadiazole), 1684 (C=O quinazolinone), 2928, 2854 (CH_2), 3449 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.52 (s, 2H, H-11), 6.40 (d, $J = 7.92$ Hz, 1H, H-14), 6.89 (t, $J = 7.36$ Hz, 1H, H-16), 7.04-7.10 (m, 2H, H-15,22), 7.21 (d, $J = 7.5$ Hz, 1H, H-17), 7.25 (d, $J = 8.28$ Hz, 1H, H-8), 7.41 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.48 (t, $J = 7.56$ Hz, 1H, H-33), 7.55 (t, $J = 7.9$ Hz, 1H, H-36), 7.64 (d, $J = 7.84$ Hz, 1H, H-32), 7.69 (d, $J = 7.48$ Hz, 1H, H-35), 7.93 (d, $J = 8.28$ Hz, 1H, H-7), 8.28 (s, 1H, H-5), 9.11 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.95 (C-11), 93.15 (C-6), 116.25 (C-16), 120.44 (C-14), 122.56 (C-10), 124.02 (C-8), 124.23 (C-22), 126.50 (C-15), 127.13 (C-12), 127.34 (C-21,23), 127.57 (C-34), 128.14 (C-35), 128.71 (C-32), 129.47 (C-20,24), 129.82 (C-33), 131.30 (C-17), 131.46 (C-31), 135.19 (C-30), 136.24 (C-5), 137.35 (C-19), 141.78 (C-13), 142.43 (C-7), 146.11 (C-9), 156.69 (C-26), 160.88 (C-4), 163.35 (C-2), 164.61 (C-29). Anal. Calcd. for $\text{C}_{29}\text{H}_{17}\text{Cl}_3\text{IN}_5\text{O}_2$: C, 49.71; H, 2.45; N, 9.99. Found: C, 49.66; H, 2.51; N, 10.02.

3-[5-(4-Chlorophenyl)-1,3,4-oxadiazol-2-yl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-quinazolin-4(3H)-one (9d)

Yield: 65%, mp: 260–265°C. IR (KBr), ν , cm^{-1} : 748 (C-Cl), 1315 (C-N), 1264, 1038 (C-O-C oxadiazole), 1612 (C=N quinazolinone), 1648 (C=N oxadiazole), 1675 (C=O quinazolinone), 2923, 2848 (CH_2), 3442 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.51 (s, 2H, H-11), 6.38 (d, $J = 8.04$ Hz, 1H, H-14), 6.89 (t, $J = 7.48$ Hz, 1H, H-16), 7.03-7.10 (m, 2H, H-15,22), 7.22 (d, $J = 7.62$ Hz, 1H, H-17), 7.43 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.49 (t, $J = 7.6$ Hz, 1H, H-6), 7.61 (d, $J = 8.08$ Hz, 1H, H-8), 7.65 (d, $J = 8.24$ Hz, 2H, H-32,34), 7.70 (d, $J = 8.24$ Hz, 2H, H-31,35), 7.74 (t, $J = 7.8$ Hz, 1H, H-7), 8.11 (d, $J = 7.72$ Hz, 1H, H-5), 9.07 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.51 (C-11), 116.30 (C-16), 120.43 (C-14), 120.75 (C-10), 122.52 (C-8), 123.32 (C-30), 124.33 (C-22), 126.57 (C-15), 127.23 (C-12), 127.41 (C-21,23), 127.60 (C-6), 128.78 (C-5), 129.37 (C-20,24), 131.20 (C-17), 131.82 (C-31,35), 133.21 (C-32,34), 133.68 (C-7), 135.43 (C-33), 137.36 (C-19), 141.70 (C-13), 147.17 (C-9), 156.62 (C-26), 160.78 (C-4), 163.37 (C-2), 164.67 (C-29). Anal. Calcd. for $\text{C}_{29}\text{H}_{18}\text{Cl}_3\text{N}_5\text{O}_2$: C, 60.59; H, 3.16; N, 12.18. Found: C, 60.51; H, 3.19; N, 12.15.

6-Bromo-3-[5-(4-chlorophenyl)-1,3,4-oxadiazol-2-yl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (9e)

Yield: 61%, mp: 254–258°C. IR (KBr), ν , cm^{-1} : 568 (C-Br), 743 (C-Cl), 1316 (C-N), 1258, 1032 (C-O-C oxadiazole), 1613 (C=N quinazolinone), 1650 (C=N oxadiazole), 1674 (C=O quinazolinone), 2922, 2849 (CH_2), 3444 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.52 (s, 2H, H-11), 6.41 (d, $J = 8$ Hz, 1H, H-14), 6.90 (t, $J = 7.44$ Hz, 1H, H-16), 7.04-7.10 (m, 2H, H-15,22), 7.20 (d, $J = 7.58$ Hz, 1H, H-17), 7.42 (d, $J = 8.08$ Hz, 2H, H-21,23), 7.60 (d, $J = 8.32$ Hz, 1H, H-8), 7.64 (d, $J = 8.2$ Hz, 2H, H-32,34), 7.69 (d, $J = 8.2$ Hz, 2H, H-31,35), 8.01 (d, $J = 8.32$ Hz, 1H, H-7), 8.09 (s, 1H, H-5), 9.08 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.57 (C-11), 116.28 (C-16), 120.56 (C-14), 123.16 (C-10), 123.33 (C-30), 124.27 (C-22), 124.56 (C-8), 126.48 (C-15), 127.22 (C-12), 127.39 (C-21,23), 127.67 (C-6), 129.35 (C-20,24), 131.18 (C-17), 131.79 (C-31,35), 132.24 (C-5), 133.24 (C-32,34), 135.39 (C-33), 136.35 (C-7), 137.38 (C-19), 141.76 (C-13), 146.23 (C-9), 156.58 (C-26),

160.61 (C-4), 163.41 (C-2), 164.54 (C-29). Anal. Calcd. for $C_{29}H_{17}BrCl_3N_5O_2$: C, 53.28; H, 2.62; N, 10.71. Found: C, 53.35; H, 2.66; N, 10.58.

3-[5-(4-Chlorophenyl)-1,3,4-oxadiazol-2-yl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-6-iodoquinazolin-4(3H)-one (9f)

Yield: 68%, mp: 273–277°C. IR (KBr), ν , cm^{-1} : 615 (C-I), 746 (C-Cl), 1315 (C-N), 1260, 1045 (C-O-C oxadiazole), 1612 (C=N quinazolinone), 1651 (C=N oxadiazole), 1680 (C=O quinazolinone), 2927, 2852 (CH_2), 3450 (NH). 1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.51 (s, 2H, H-11), 6.41 (d, $J = 7.92$ Hz, 1H, H-14), 6.88 (t, $J = 7.36$ Hz, 1H, H-16), 7.05–7.08 (m, 2H, H-15,22), 7.21 (d, $J = 7.54$ Hz, 1H, H-17), 7.25 (d, $J = 8.36$ Hz, 1H, H-8), 7.41 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.62 (d, $J = 8.28$ Hz, 2H, H-32,34), 7.68 (d, $J = 8.28$ Hz, 2H, H-31,35), 7.95 (d, $J = 8.36$ Hz, 1H, H-7), 8.28 (s, 1H, H-5), 9.11 (bs, 1H, H-18). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 33.05 (C-11), 93.18 (C-6), 116.29 (C-16), 120.42 (C-14), 122.58 (C-10), 123.30 (C-30), 124.08 (C-8), 124.25 (C-22), 126.52 (C-15), 127.16 (C-12), 127.35 (C-21,23), 129.46 (C-20,24), 131.32 (C-17), 131.77 (C-31,35), 133.25 (C-32,34), 135.41 (C-33), 136.23 (C-5), 137.34 (C-19), 141.76 (C-13), 142.45 (C-7), 146.13 (C-9), 156.65 (C-26), 160.89 (C-4), 163.37 (C-2), 164.62 (C-29). Anal. Calcd. for $C_{29}H_{17}Cl_3IN_5O_2$: C, 49.71; H, 2.45; N, 9.99. Found: C, 49.65; H, 2.47; N, 10.04.

General procedure for 1,3,4-oxadiazolyl-quinazolin-4(3H)-ones (10a-f)

A mixture of benzoxazinones **8a–c** (2.5 mmol) and 4-(5-substituted phenyl-1,3,4-oxadiazol-2-yl)benzenamines **5a,b** (2.5 mmol) 10 ml in pyridine was refluxed on an oil bath for 6–8 h. After completion of the reaction, the oily mass was slowly poured onto crushed ice cold water containing 5 ml concentrated HCl with continues stirring. The product obtained was filtered and washed several times with cold water, dried and recrystallized from ethanol.

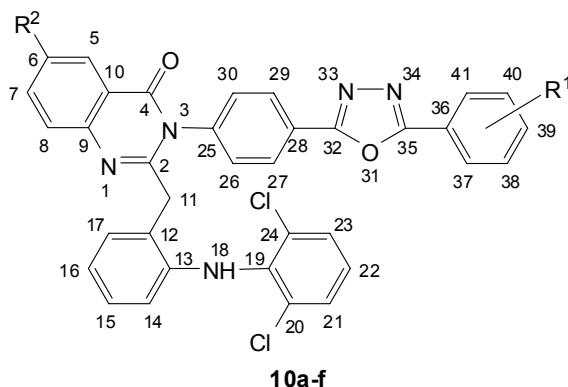


Fig. 5. Numbering of 1,3,4-Oxadiazolyl-quinazolin-4(3H)-ones **10a–f**

3-{4-[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]phenyl}-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (10a)

Yield: 62%, mp: 228–231°C. IR (KBr), ν , cm^{-1} : 740 (C-Cl), 1316 (C-N), 1265, 1041 (C-O-C oxadiazole), 1610 (C=N quinazolinone), 1656 (C=N oxadiazole), 1676 (C=O quinazolinone), 2925, 2852 (CH_2), 3446 (NH). 1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.51 (s, 2H, H-11), 6.40 (d, $J = 8$ Hz, 1H, H-14), 6.89 (t, $J = 7.4$ Hz, 1H, H-16), 7.03–7.09 (m,

2H, H-15,22), 7.22 (d, $J = 7.58$ Hz, 1H, H-17), 7.42 (d, $J = 8.16$ Hz, 2H, H-21,23), 7.45 (d, $J = 8.4$ Hz, 2H, H-26,30), 7.47-7.55 (m, 4H, Ar-H), 7.57 (t, $J = 7.36$ Hz, 1H, H-40), 7.62 (d, $J = 8.16$ Hz, 1H, H-8), 7.66 (d, $J = 7.8$ Hz, 1H, H-38), 7.71 (d, $J = 7.48$ Hz, 1H, H-41), 7.75 (t, $J = 7.84$ Hz, 1H, H-7), 8.07 (d, $J = 7.74$ Hz, 1H, H-5), 9.11 (bs, 1H, H-18). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 32.48 (C-11), 116.27 (C-16), 120.43 (C-14), 120.81 (C-10), 121.47 (C-28), 121.82 (C-26,30), 122.58 (C-8), 124.34 (C-22), 126.57 (C-15), 127.23 (C-12), 127.40 (C-21,23), 127.51 (C-40), 127.61 (C-6), 127.72 (C-27,29), 128.14 (C-41), 128.67 (C-38), 128.78 (C-5), 129.33 (C-20,24), 129.78 (C-39), 131.18 (C-17), 131.43 (C-37), 132.64 (C-25), 133.62 (C-7), 135.22 (C-36), 137.34 (C-19), 141.67 (C-13), 147.12 (C-9), 160.73 (C-4), 163.26 (C-2), 164.64 (C-32, 35). Anal. Calcd. for $\text{C}_{35}\text{H}_{22}\text{Cl}_3\text{N}_5\text{O}_2$: C, 64.58; H, 3.41; N, 10.76. Found: C, 64.51; H, 3.46; N, 10.71.

6-Bromo-3-{4-[5-(2-chlorophenyl)-1,3,4-oxadiazol-2-yl]phenyl}-2-{2-[(2,6-dichlorophenyl)-amino]benzyl}quinazolin-4(3H)-one (10b)

Yield: 64%, mp: 213–217°C. IR (KBr), ν , cm^{-1} : 572 (C-Br), 743 (C-Cl), 1312 (C-N), 1268, 1048 (C-O-C oxadiazole), 1609 (C=N quinazolinone), 1653 (C=N oxadiazole), 1681 (C=O quinazolinone), 2921, 2847 (CH_2), 3442 (NH). ^1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.53 (s, 2H, H-11), 6.42 (d, $J = 7.96$ Hz, 1H, H-14), 6.91 (t, $J = 7.44$ Hz, 1H, H-16), 7.03-7.10 (m, 2H, H-15,22), 7.23 (d, $J = 7.58$ Hz, 1H, H-17), 7.42 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.45 (d, $J = 8.36$ Hz, 2H, H-26,30), 7.48 (t, $J = 7.56$ Hz, 1H, H-39), 7.54 (t, $J = 7.4$ Hz, 1H, H-40), 7.57 (d, $J = 8.36$ Hz, 2H, H-27,29), 7.61 (d, $J = 8.4$ Hz, 1H, H-8), 7.65 (d, $J = 7.8$ Hz, 1H, H-38), 7.72 (d, $J = 7.48$ Hz, 1H, H-41), 8.05 (d, $J = 8.4$ Hz, 1H, H-7), 8.12 (s, 1H, H-5), 9.11 (bs, 1H, H-18). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 32.63 (C-11), 116.27 (C-16), 120.55 (C-14), 121.52 (C-28), 121.78 (C-26,30), 123.12 (C-10), 124.26 (C-22), 124.62 (C-8), 126.50 (C-15), 127.17 (C-12), 127.38 (C-21,23), 127.53 (C-40), 127.64 (C-6), 127.73 (C-27,29), 128.17 (C-41), 128.76 (C-38), 129.37 (C-20,24), 129.82 (C-39), 131.20 (C-17), 131.45 (C-37), 132.27 (C-5), 132.64 (C-25), 135.23 (C-36), 136.35 (C-7), 137.32 (C-19), 141.74 (C-13), 146.23 (C-9), 160.60 (C-4), 163.28 (C-2), 164.59 (C-32,35). Anal. Calcd. for $\text{C}_{35}\text{H}_{21}\text{BrCl}_3\text{N}_5\text{O}_2$: C, 57.60; H, 2.90; N, 9.60. Found: C, 57.52; H, 2.94; N, 9.63.

3-{4-[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]phenyl}-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-6-iodoquinazolin-4(3H)-one (10c)

Yield: 60%, mp: 235–238°C. IR (KBr), ν , cm^{-1} : 620 (C-I), 748 (C-Cl), 1312 (C-N), 1270, 1051 (C-O-C oxadiazole), 1611 (C=N quinazolinone), 1649 (C=N oxadiazole), 1678 (C=O quinazolinone), 2928, 2855 (CH_2), 3448 (NH). ^1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.52 (s, 2H, H-11), 6.41 (d, $J = 8$ Hz, 1H, H-14), 6.88 (t, $J = 7.44$ Hz, 1H, H-16), 7.05-7.11 (m, 2H, H-15,22), 7.23 (d, $J = 7.54$ Hz, 1H, H-17), 7.26 (d, $J = 8.32$ Hz, 1H, H-8), 7.43 (d, $J = 8.04$ Hz, 2H, H-21,23), 7.46 (d, $J = 8.44$ Hz, 2H, H-26,30), 7.49 (t, $J = 7.6$ Hz, 1H, H-39), 7.53 (d, $J = 8.44$ Hz, 2H, H-27,29), 7.56 (t, $J = 7.42$ Hz, 1H, H-40), 7.63 (d, $J = 7.88$ Hz, 1H, H-38), 7.69 (d, $J = 7.56$ Hz, 1H, H-41), 7.93 (d, $J = 8.32$ Hz, 1H, H-7), 8.28 (s, 1H, H-5), 9.09 (bs, 1H, H-18). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 32.90 (C-11), 93.21 (C-6), 116.29 (C-16), 120.48 (C-14), 121.49 (C-28), 121.81 (C-26,30), 122.55 (C-10), 124.05 (C-8), 124.25 (C-22), 126.49 (C-15), 127.15 (C-12), 127.38 (C-21,23), 127.49 (C-40), 127.68 (C-27,29), 128.12 (C-41), 128.68 (C-38), 129.44 (C-20,24), 129.74 (C-39), 131.29 (C-17), 131.40 (C-37), 132.58 (C-25), 135.18 (C-36), 136.21 (C-5), 137.37 (C-19), 141.75 (C-13), 142.46 (C-7), 146.09 (C-9), 160.95 (C-4), 163.22 (C-2), 164.63 (C-32,35). Anal. Calcd. for $\text{C}_{35}\text{H}_{21}\text{Cl}_3\text{IN}_5\text{O}_2$: C, 54.11; H, 2.72; N, 9.02. Found: C, 54.18; H, 2.76; N, 8.95.

3-{4-[5-(4-Chlorophenyl)-1,3,4-oxadiazol-2-yl]phenyl}-2-{2-[(2,6-dichlorophenyl)amino]-benzyl}quinazolin-4(3H)-one (10d)

Yield: 59%, mp: 245–248°C. IR (KBr), ν , cm^{-1} : 748 (C-Cl), 1318 (C-N), 1275, 1045 (C-O-C oxadiazole), 1613 (C=N quinazolinone), 1658 (C=N oxadiazole), 1680 (C=O quinazolinone), 2925, 2852 (CH_2), 3451 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.52 (s, 2H, H-11), 6.40 (d, $J = 7.88$ Hz, 1H, H-14), 6.89 (t, $J = 7.36$ Hz, 1H, H-16), 7.04–7.09 (m, 2H, H-15,22), 7.21 (d, $J = 7.5$ Hz, 1H, H-17), 7.42 (d, $J = 8.08$ Hz, 2H, H-21,23), 7.45 (d, $J = 8.36$ Hz, 2H, H-26,30), 7.49 (t, $J = 7.6$ Hz, 1H, H-6), 7.56 (d, $J = 8.36$ Hz, 2H, H-27,29), 7.61 (d, $J = 8.12$ Hz, 1H, H-8), 7.65 (d, $J = 8.28$ Hz, 2H, H-37,41), 7.68 (d, $J = 8.28$ Hz, 2H, H-38,40), 7.75 (t, $J = 7.8$ Hz, 1H, H-7), 8.09 (d, $J = 7.68$ Hz, 1H, H-5), 9.10 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.61 (C-11), 116.30 (C-16), 120.45 (C-14), 120.75 (C-10), 121.52 (C-28), 121.78 (C-26,30), 122.57 (C-8), 123.28 (C-36), 124.32 (C-22), 126.51 (C-15), 127.19 (C-12), 127.37 (C-21,23), 127.56 (C-6), 127.68 (C-27,29), 128.74 (C-5), 129.32 (C-20,24), 131.15 (C-17), 131.83 (C-37,41), 132.59 (C-25), 133.19 (C-38,40), 133.64 (C-7), 135.42 (C-39), 137.34 (C-19), 141.65 (C-13), 147.13 (C-9), 160.77 (C-4), 163.38 (C-2), 164.61 (C-32,35). Anal. Calcd. for $\text{C}_{35}\text{H}_{22}\text{Cl}_3\text{N}_5\text{O}_2$: C, 64.58; H, 3.41; N, 10.76. Found: C, 64.53; H, 3.44; N, 10.73.

6-Bromo-3-{4-[5-(4-chlorophenyl)-1,3,4-oxadiazol-2-yl]phenyl}-2-{2-[(2,6-dichlorophenyl)-amino]benzyl}quinazolin-4(3H)-one (10e)

Yield: 68%, mp: 221–224°C. IR (KBr), ν , cm^{-1} : 565 (C-Br), 747 (C-Cl), 1317 (C-N), 1266, 1044 (C-O-C oxadiazole), 1609 (C=N quinazolinone), 1650 (C=N oxadiazole), 1676 (C=O quinazolinone), 2923, 2852 (CH_2), 3446 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.53 (s, 2H, H-11), 6.41 (d, $J = 7.96$ Hz, 1H, H-14), 6.90 (t, $J = 7.4$ Hz, 1H, H-16), 7.04–7.10 (m, 2H, H-15,22), 7.20 (d, $J = 7.58$ Hz, 1H, H-17), 7.42 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.46 (d, $J = 8.4$ Hz, 2H, H-26,30), 7.56 (d, $J = 8.4$ Hz, 2H, H-27,29), 7.60 (d, $J = 8.28$ Hz, 1H, H-8), 7.64 (d, $J = 8.24$ Hz, 2H, H-38,40), 7.69 (d, $J = 8.24$ Hz, 2H, H-37,41), 8.07 (d, $J = 8.28$ Hz, 1H, H-7), 8.13 (s, 1H, H-5), 9.11 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 32.67 (C-11), 116.25 (C-16), 120.56 (C-14), 121.53 (C-28), 121.79 (C-26,30), 123.16 (C-10), 123.32 (C-36), 124.27 (C-22), 124.56 (C-8), 126.44 (C-15), 127.15 (C-12), 127.34 (C-21,23), 127.62 (C-6), 127.74 (C-27,29), 129.38 (C-20,24), 131.22 (C-17), 131.82 (C-37,41), 132.28 (C-5), 132.62 (C-25), 133.22 (C-38,40), 135.41 (C-39), 136.35 (C-7), 137.32 (C-19), 141.73 (C-13), 146.25 (C-9), 160.56 (C-4), 163.37 (C-2), 164.52 (C-32,35). Anal. Calcd. for $\text{C}_{35}\text{H}_{21}\text{BrCl}_3\text{N}_5\text{O}_2$: C, 57.60; H, 2.90; N, 9.60. Found: C, 57.53; H, 2.93; N, 9.55.

3-{4-[5-(4-Chlorophenyl)-1,3,4-oxadiazol-2-yl]phenyl}-2-{2-[(2,6-dichlorophenyl)amino]-benzyl}-6-iodoquinazolin-4(3H)-one (10f)

Yield: 65%, mp: 257–261°C. IR (KBr), ν , cm^{-1} : 617 (C-I), 745 (C-Cl), 1314 (C-N), 1268, 1052 (C-O-C oxadiazole), 1608 (C=N quinazolinone), 1652 (C=N oxadiazole), 1679 (C=O quinazolinone), 2925, 2851 (CH_2), 3443 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.51 (s, 2H, H-11), 6.39 (d, $J = 8$ Hz, 1H, H-14), 6.88 (t, $J = 7.48$ Hz, 1H, H-16), 7.03–7.10 (m, 2H, H-15,22), 7.20 (d, $J = 7.58$ Hz, 1H, H-17), 7.24 (d, $J = 8.24$ Hz, 1H, H-8), 7.43 (d, $J = 8.16$ Hz, 2H, H-21,23), 7.47 (d, $J = 8.32$ Hz, 2H, H-26,30), 7.58 (d, $J = 8.32$ Hz, 2H, H-27,29), 7.63 (d, $J = 8.2$ Hz, 2H, H-38,40), 7.68 (d, $J = 8.2$ Hz, 2H, H-37,41), 7.95 (d, $J = 8.24$ Hz, 1H, H-7), 8.28 (s, 1H, H-5), 9.12 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 33.01 (C-11), 93.20 (C-6), 116.21 (C-16), 120.43 (C-14), 121.48 (C-28), 121.76

(C-26,30), 122.55 (C-10), 123.34 (C-36), 124.06 (C-8), 124.25 (C-22), 126.48 (C-15), 127.14 (C-12), 127.32 (C-21,23), 127.67 (C-27,29), 129.43 (C-20,24), 131.33 (C-17), 131.82 (C-37,41), 132.63 (C-25), 133.23 (C-38,40), 135.44 (C-39), 136.28 (C-5), 137.34 (C-19), 141.76 (C-13), 142.48 (C-7), 146.15 (C-9), 160.93 (C-4), 163.31 (C-2), 164.59 (C-32,35). Anal. Calcd. for $C_{35}H_{21}Cl_3IN_5O_2$: C, 54.11; H, 2.72; N, 9.02. Found: C, 54.06; H, 2.75; N, 9.09.

General procedure for quinazolin-4(3H)-ones (11a–c)

A mixture of benzoxazinones **8a–c** (5 mmol) and glycine (5 mmol) was refluxed in 20 ml butanol for 6–8 h. After completion of the reaction, it was concentrated and after cooling, water was added and solid thus obtained was filtered off and recrystallized from ethanol.

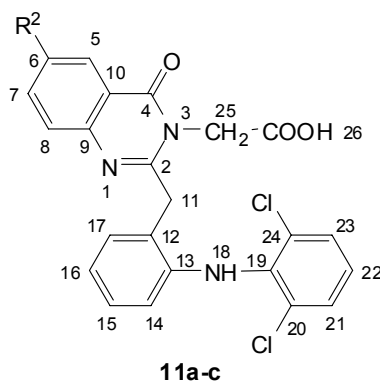


Fig. 6. Numbering of Quinazolin-4(3H)-ones **11a–c**

[2-{2-[(2,6-Dichlorophenyl)amino]benzyl}-4-oxoquinazolin-3(4H)-yl]acetic acid (**11a**)

Yield: 53%, mp: 202–206°C. IR (KBr), ν , cm^{-1} : 741 (C-Cl), 1315 (C-N), 1608 (C=N quinazolinone), 1686 (C=O quinazolinone), 1715 (C=O), 2780 (OH), 2924, 2851 (CH_2), 3447 (NH). 1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.52 (s, 2H, H-11), 4.15 (s, 2H, H-25), 6.39 (d, $J = 7.96$ Hz, 1H, H-14), 6.88 (t, $J = 7.44$ Hz, 1H, H-16), 7.04–7.09 (m, 2H, H-15,22), 7.21 (d, $J = 7.58$ Hz, 1H, H-17), 7.42 (d, $J = 8.08$ Hz, 2H, H-21,23), 7.48 (t, $J = 7.72$ Hz, 1H, H-6), 7.62 (d, $J = 8.2$ Hz, 1H, H-8), 7.75 (t, $J = 7.88$ Hz, 1H, H-7), 8.10 (d, $J = 7.8$ Hz, 1H, H-5), 9.10 (bs, 1H, H-18), 12.34 (bs, 1H, H-26). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 32.62 (C-11), 42.93 (C-25), 116.31 (C-16), 120.44 (C-14), 120.91 (C-10), 122.52 (C-8), 124.29 (C-22), 126.51 (C-15), 127.18 (C-12), 127.37 (C-21,23), 127.82 (C-6), 128.71 (C-5), 129.32 (C-20,24), 131.14 (C-17), 135.74 (C-7), 137.28 (C-19), 141.71 (C-13), 147.13 (C-9), 160.72 (C-4), 164.63 (C-2), 173.52 (C-26). Anal. Calcd. for $C_{23}H_{17}Cl_2N_3O_3$: C, 60.81; H, 3.77; N, 9.25. Found: C, 60.75; H, 3.70; N, 9.28.

[6-Bromo-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-4-oxoquinazolin-3(4H)-yl]acetic acid (**11b**)

Yield: 56%, mp: 223–227°C. IR (KBr), ν , cm^{-1} : 567 (C-Br), 744 (C-Cl), 1317 (C-N), 1610 (C=N quinazolinone), 1684 (C=O quinazolinone), 1718 (C=O), 2785 (OH), 2925, 2849 (CH_2), 3445 (NH). 1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.53 (s, 2H, H-11), 4.14 (s, 2H, H-25), 6.40 (d, $J = 8$ Hz, 1H, H-14), 6.88 (t, $J = 7.4$ Hz, 1H, H-16), 7.03–7.08 (m, 2H, H-15,22), 7.22 (d, $J = 7.5$ Hz, 1H, H-17), 7.41 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.63 (d, $J = 8.36$

Hz, 1H, H-8), 7.95 (d, $J = 8.36$ Hz, 1H, H-7), 8.03 (s, 1H, H-5), 9.09 (bs, 1H, H-18), 12.35 (bs, 1H, H-26). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 32.73 (C-11), 43.32 (C-25), 116.28 (C-16), 120.57 (C-14), 121.65 (C-6), 122.94 (C-10), 124.19 (C-22), 124.51 (C-8), 126.42 (C-15), 127.15 (C-12), 127.38 (C-21,23), 129.31 (C-20,24), 131.22 (C-17), 132.14 (C-5), 137.37 (C-19), 138.33 (C-7), 141.81 (C-13), 145.83 (C-9), 160.93 (C-4), 164.55 (C-2), 173.47 (C-26). Anal. Calcd. for $\text{C}_{23}\text{H}_{16}\text{BrCl}_2\text{N}_3\text{O}_3$: C, 51.81; H, 3.02; N, 7.88. Found: C, 51.85; H, 3.05; N, 7.84.

[2-{2-[(2,6-Dichlorophenyl)amino]benzyl}-6-iodo-4-oxoquinazolin-3(4H)-yl]acetic acid (11c)

Yield: 60%, mp: 211–214°C. IR (KBr), ν , cm^{-1} : 618 (C-I), 746 (C-Cl), 1318 (C-N), 1612 (C=N quinazolinone), 1682 (C=O quinazolinone), 1713 (C=O), 2778 (OH), 2922, 2846 (CH_2), 3443 (NH). ^1H NMR (400 MHz, DMSO- d_6 , TMS): δ 3.53 (s, 2H, H-11), 4.16 (s, 2H, H-25), 6.41 (d, $J = 7.92$ Hz, 1H, H-14), 6.89 (t, $J = 7.36$ Hz, 1H, H-16), 7.04–7.09 (m, 2H, H-15,22), 7.22 (d, $J = 7.5$ Hz, 1H, H-17), 7.26 (d, $J = 8.32$ Hz, 1H, H-8), 7.42 (d, $J = 8.04$ Hz, 2H, H-21,23), 7.94 (d, $J = 8.32$ Hz, 1H, H-7), 8.27 (s, 1H, H-5), 9.09 (bs, 1H, H-18), 12.35 (bs, 1H, H-26). ^{13}C NMR (100 MHz, DMSO- d_6 , TMS): δ 33.12 (C-11), 43.26 (C-25), 93.32 (C-6), 116.26 (C-16), 120.51 (C-14), 122.52 (C-10), 123.92 (C-8), 124.13 (C-22), 126.58 (C-15), 126.98 (C-12), 127.26 (C-21,23), 129.32 (C-20,24), 131.24 (C-17), 136.14 (C-5), 137.28 (C-19), 141.67 (C-13), 142.45 (C-7), 145.74 (C-9), 161.16 (C-4), 164.62 (C-2), 173.44 (C-26). Anal. Calcd. for $\text{C}_{23}\text{H}_{16}\text{Cl}_2\text{I}_2\text{N}_3\text{O}_3$: C, 47.61; H, 2.78; N, 7.24. Found: C, 47.57; H, 2.75; N, 7.25.

General procedure for 1,3,4-oxadiazolyl-quinazolin-4(3H)-ones (12a–f)

A mixture of **11a–c** (2.5 mmol), benzohydrazides **3a,b** (2.5 mmol) and 7 ml phosphorus trichloride in 10 ml dry benzene was refluxed under anhydrous condition for 10–12 h. After completion of reaction, benzene was distilled off under reduced pressure and the residue poured on to crushed ice and neutralized with sodium bicarbonate (5% w/v). The solid thus obtained was filtered, washed with cold water and recrystallized from ethanol.

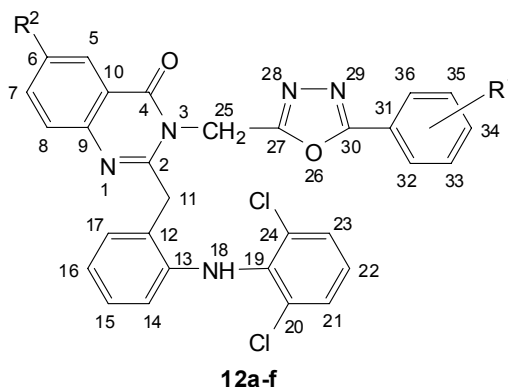


Fig. 7. Numbering of 1,3,4-Oxadiazolyl-quinazolin-4(3H)-ones **12a–f**

3-[[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (12a)

Yield: 72%, mp: 181–184°C. IR (KBr), ν , cm^{-1} : 744 (C-Cl), 1313 (C-N), 1259, 1035 (C-O-C oxadiazole), 1611 (C=N quinazolinone), 1653 (C=N oxadiazole), 1678 (C=O

quinazolinone), 2923, 2855 (CH₂), 3448 (NH). ¹H NMR (400 MHz, DMSO-*d*₆, TMS): δ 3.51 (s, 2H, H-11), 4.49 (s, 2H, H-25), 6.40 (d, *J* = 7.96 Hz, 1H, H-14), 6.89 (t, *J* = 7.44 Hz, 1H, H-16), 7.05-7.10 (m, 2H, H-15,22), 7.22 (d, *J* = 7.58 Hz, 1H, H-17), 7.42 (d, *J* = 8.12 Hz, 2H, H-21,23), 7.47 (t, *J* = 7.56 Hz, 1H, H-34), 7.51 (t, *J* = 7.64 Hz, 1H, H-6), 7.56 (t, *J* = 7.4 Hz, 1H, H-35), 7.61 (d, *J* = 8.12 Hz, 1H, H-8), 7.67 (d, *J* = 7.84 Hz, 1H, H-33), 7.71 (d, *J* = 7.48 Hz, 1H, H-36), 7.75 (t, *J* = 7.8 Hz, 1H, H-7), 8.09 (d, *J* = 7.72 Hz, 1H, H-5), 9.10 (bs, 1H, H-18). ¹³C NMR (100 MHz, DMSO-*d*₆, TMS): δ 33.02 (C-11), 42.42 (C-25), 116.32 (C-16), 120.45 (C-14), 120.93 (C-10), 122.57 (C-8), 124.31 (C-22), 126.54 (C-15), 127.22 (C-12), 127.39 (C-21,23), 127.61 (C-35), 127.83 (C-6), 128.24 (C-36), 128.73 (C-5), 128.82 (C-33), 129.37 (C-20,24), 129.75 (C-34), 131.18 (C-17), 131.79 (C-32), 135.47 (C-31), 135.81 (C-7), 137.34 (C-19), 141.75 (C-13), 147.18 (C-9), 156.28 (C-27), 160.74 (C-4), 163.46 (C-2), 164.65 (C-30). Anal. Calcd. for C₃₀H₂₀Cl₃N₅O₂: C, 61.19; H, 3.42; N, 11.89. Found: C, 61.12; H, 3.47; N, 11.85.

6-Bromo-3-[[5-(2-chlorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (12b)

Yield: 68%, mp: 175–178°C. IR (KBr), v, cm⁻¹: 568 (C-Br), 742 (C-Cl), 1311 (C-N), 1263, 1045 (C-O-C oxadiazole), 1612 (C=N quinazolinone), 1653 (C=N oxadiazole), 1675 (C=O quinazolinone), 2922, 2850 (CH₂), 3443 (NH). ¹H NMR (400 MHz, DMSO-*d*₆, TMS): δ 3.53 (s, 2H, H-11), 4.48 (s, 2H, H-25), 6.40 (d, *J* = 8 Hz, 1H, H-14), 6.88 (t, *J* = 7.48 Hz, 1H, H-16), 7.03-7.08 (m, 2H, H-15,22), 7.22 (d, *J* = 7.58 Hz, 1H, H-17), 7.41 (d, *J* = 8.08 Hz, 2H, H-21,23), 7.49 (t, *J* = 7.52 Hz, 1H, H-34), 7.56 (t, *J* = 7.36 Hz, 1H, H-35), 7.62 (d, *J* = 8.28 Hz, 1H, H-8), 7.67 (d, *J* = 7.8 Hz, 1H, H-33), 7.72 (d, *J* = 7.48 Hz, 1H, H-36), 8.06 (d, *J* = 8.28 Hz, 1H, H-7), 8.11 (s, 1H, H-5), 9.10 (bs, 1H, H-18). ¹³C NMR (100 MHz, DMSO-*d*₆, TMS): δ 33.14 (C-11), 42.47 (C-25), 116.32 (C-16), 120.63 (C-14), 121.68 (C-6), 122.96 (C-10), 124.22 (C-22), 124.54 (C-8), 126.46 (C-15), 127.17 (C-12), 127.42 (C-21,23), 127.67 (C-35), 128.26 (C-36), 128.72 (C-33), 129.35 (C-20,24), 129.69 (C-34), 131.24 (C-17), 131.84 (C-32), 132.16 (C-5), 135.52 (C-31), 137.43 (C-19), 138.37 (C-7), 141.84 (C-13), 145.85 (C-9), 156.25 (C-27), 160.97 (C-4), 163.41 (C-2), 164.56 (C-30). Anal. Calcd. for C₃₀H₁₉BrCl₃N₅O₂: C, 53.96; H, 2.87; N, 10.49. Found: C, 53.88; H, 2.85; N, 10.53.

3-[[5-(2-Chlorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-6-iodoquinazolin-4(3H)-one (12c)

Yield: 62%, mp: 196–98°C. IR (KBr), v, cm⁻¹: 620 (C-I), 745 (C-Cl), 1316 (C-N), 1265, 1036 (C-O-C oxadiazole), 1609 (C=N quinazolinone), 1650 (C=N oxadiazole), 1678 (C=O quinazolinone), 2924, 2850 (CH₂), 3445 (NH). ¹H NMR (400 MHz, DMSO-*d*₆, TMS): δ 3.53 (s, 2H, H-11), 4.48 (s, 2H, H-25), 6.41 (d, *J* = 8 Hz, 1H, H-14), 6.89 (t, *J* = 7.48 Hz, 1H, H-16), 7.04-7.09 (m, 2H, H-15,22), 7.22 (d, *J* = 7.62 Hz, 1H, H-17), 7.26 (d, *J* = 8.36 Hz, 1H, H-8), 7.42 (d, *J* = 8.12 Hz, 2H, H-21,23), 7.50 (t, *J* = 7.52 Hz, 1H, H-34), 7.56 (t, *J* = 7.36 Hz, 1H, H-35), 7.65 (d, *J* = 7.8 Hz, 1H, H-33), 7.71 (d, *J* = 7.44 Hz, 1H, H-36), 7.94 (d, *J* = 8.36 Hz, 1H, H-7), 8.27 (s, 1H, H-5), 9.09 (bs, 1H, H-18). ¹³C NMR (100 MHz, DMSO-*d*₆, TMS): δ 33.51 (C-11), 42.47 (C-25), 93.33 (C-6), 116.27 (C-16), 120.53 (C-14), 122.55 (C-10), 123.91 (C-8), 124.16 (C-22), 126.62 (C-15), 127.11 (C-12), 127.28 (C-21,23), 127.64 (C-35), 128.26 (C-36), 128.73 (C-33), 129.37 (C-20,24), 129.75 (C-34), 131.28 (C-17), 131.84 (C-32), 136.15 (C-5), 135.52 (C-31), 137.31 (C-19), 141.70 (C-13), 142.48 (C-7), 145.77 (C-9), 156.23 (C-27), 161.18 (C-4), 163.44 (C-2), 164.67 (C-30). Anal. Calcd. for C₃₀H₁₉Cl₃I₁N₅O₂: C, 50.41; H, 2.68; N, 9.80. Found: C, 50.45; H, 2.71; N, 9.73.

3-[[5-(4Chlorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (12d)

Yield: 71%, mp: 227–30°C. IR (KBr), ν , cm^{-1} : 748 (C-Cl), 1316 (C-N), 1254, 1038 (C-O-C oxadiazole), 1608 (C=N quinazolinone), 1655 (C=N oxadiazole), 1683 (C=O quinazolinone), 2922, 2851 (CH_2), 3443 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.52 (s, 2H, H-11), 4.47 (s, 2H, H-25), 6.39 (d, $J = 8.04$ Hz, 1H, H-14), 6.88 (t, $J = 7.52$ Hz, 1H, H-16), 7.04–7.09 (m, 2H, H-15,22), 7.21 (d, $J = 7.62$ Hz, 1H, H-17), 7.42 (d, $J = 8.16$ Hz, 2H, H-21,23), 7.50 (t, $J = 7.68$ Hz, 1H, H-6), 7.62 (d, $J = 8.16$ Hz, 1H, H-8), 7.65 (d, $J = 8.2$ Hz, 2H, H-33,35), 7.70 (d, $J = 8.2$ Hz, 2H, H-32,36), 7.74 (t, $J = 7.84$ Hz, 1H, H-7), 8.08 (d, $J = 7.76$ Hz, 1H, H-5), 9.12 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 33.05 (C-11), 42.23 (C-25), 116.35 (C-16), 120.48 (C-14), 120.96 (C-10), 122.55 (C-8), 123.34 (C-31), 124.34 (C-22), 126.53 (C-15), 127.26 (C-12), 127.34 (C-21,23), 127.77 (C-6), 128.74 (C-5), 129.35 (C-20,24), 131.21 (C-17), 131.83 (C-32,36), 133.26 (C-33,35), 135.38 (C-34), 135.78 (C-7), 137.36 (C-19), 141.76 (C-13), 147.18 (C-9), 156.27 (C-27), 160.78 (C-4), 163.38 (C-2), 164.67 (C-30). Anal. Calcd. for $\text{C}_{30}\text{H}_{20}\text{Cl}_3\text{N}_5\text{O}_2$: C, 61.19; H, 3.42; N, 11.89. Found: C, 61.22; H, 3.38; N, 11.84.

6-Bromo-3-[[5-(4chlorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}quinazolin-4(3H)-one (12e)

Yield: 67%, mp: 266–69°C. IR (KBr), ν , cm^{-1} : 571 (C-Br), 750 (C-Cl), 1313 (C-N), 1263, 1041 (C-O-C oxadiazole), 1607 (C=N quinazolinone), 1656 (C=N oxadiazole), 1678 (C=O quinazolinone), 2925, 2853 (CH_2), 3448 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.53 (s, 2H, H-11), 4.49 (s, 2H, H-25), 6.40 (d, $J = 7.88$ Hz, 1H, H-14), 6.89 (t, $J = 7.32$ Hz, 1H, H-16), 7.02–7.08 (m, 2H, H-15,22), 7.20 (d, $J = 7.46$ Hz, 1H, H-17), 7.42 (d, $J = 8.04$ Hz, 2H, H-21,23), 7.60 (d, $J = 8.32$ Hz, 1H, H-8), 7.65 (d, $J = 8.24$ Hz, 2H, H-33,35), 7.72 (d, $J = 8.24$ Hz, 2H, H-32,36), 8.05 (d, $J = 8.32$ Hz, 1H, H-7), 8.12 (s, 1H, H-5), 9.08 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 33.15 (C-11), 42.51 (C-25), 116.25 (C-16), 120.54 (C-14), 121.63 (C-6), 122.87 (C-10), 123.30 (C-31), 124.15 (C-22), 124.46 (C-8), 126.38 (C-15), 127.17 (C-12), 127.42 (C-21,23), 129.28 (C-20,24), 131.25 (C-17), 131.78 (C-32,36), 132.12 (C-5), 133.23 (C-33,35), 135.46 (C-34), 137.42 (C-19), 138.32 (C-7), 141.83 (C-13), 145.85 (C-9), 156.31 (C-27), 160.94 (C-4), 163.37 (C-2), 164.57 (C-30). Anal. Calcd. for $\text{C}_{30}\text{H}_{19}\text{BrCl}_3\text{N}_5\text{O}_2$: C, 53.96; H, 2.87; N, 10.49. Found: C, 53.91; H, 2.82; N, 10.48.

3-[[5-(4Clorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-2-{2-[(2,6-dichlorophenyl)amino]benzyl}-6-iodoquinazolin-4(3H)-one (12f)

Yield: 75%, mp: 243–46°C. IR (KBr), ν , cm^{-1} : 618 (C-I), 749 (C-Cl), 1315 (C-N), 1260, 1049 (C-O-C oxadiazole), 1611 (C=N quinazolinone), 1658 (C=N oxadiazole), 1683 (C=O quinazolinone), 2921, 2849 (CH_2), 3445 (NH). ^1H NMR (400 MHz, $\text{DMSO-}d_6$, TMS): δ 3.51 (s, 2H, H-11), 4.48 (s, 2H, H-25), 6.42 (d, $J = 7.96$ Hz, 1H, H-14), 6.90 (t, $J = 7.4$ Hz, 1H, H-16), 7.03–7.08 (m, 2H, H-15,22), 7.21 (dd, $J = 7.5$ Hz, 1.28 Hz, 1H, H-17), 7.24 (d, $J = 8.4$ Hz, 1H, H-8), 7.41 (d, $J = 8.12$ Hz, 2H, H-21,23), 7.62 (d, $J = 8.2$ Hz, 2H, H-33,35), 7.68 (d, $J = 8.2$ Hz, 2H, H-32,36), 7.93 (d, $J = 8.4$ Hz, 1H, H-7), 8.28 (s, 1H, H-5), 9.12 (bs, 1H, H-18). ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$, TMS): δ 33.47 (C-11), 42.45 (C-25), 93.38 (C-6), 116.31 (C-16), 120.56 (C-14), 122.54 (C-10), 123.33 (C-31), 123.97 (C-8), 124.17 (C-22), 126.60 (C-15), 127.02 (C-12), 127.25 (C-21,23), 129.36 (C-20,24), 131.27 (C-17), 131.77 (C-32,36), 133.29 (C-33,35), 135.45 (C-34), 136.18 (C-5), 137.33 (C-19), 141.71

(C-13), 142.48 (C-7), 145.76 (C-9), 156.31 (C-27), 161.14 (C-4), 163.49 (C-2), 164.63 (C-30). Anal. Calcd. for $C_{30}H_{19}Cl_3IN_5O_2$: C, 50.41; H, 2.68; N, 9.80. Found: C, 50.35; H, 2.76; N, 9.77.

Antimicrobial activity

The MICs of synthesized compounds were carried out by broth microdilution method as described by Rattan [35]. Antibacterial activity was screened against two gram positive bacteria (*S. aureus* MTCC 96, *S. pyogenes* MTCC 442) and two gram negative bacteria (*E. coli* MTCC 443, *P. aeruginosa* MTCC 1688). Ampicillin was used as a standard antibacterial agent. Antifungal activity was screened against three fungal species *C. albicans* MTCC 227, *A. niger* MTCC 282 and *A. clavatus* MTCC 1323. Griseofulvin was used as a standard antifungal agent.

All MTCC cultures were collected from Institute of Microbial Technology, Chandigarh and tested against above mentioned known drugs. Mueller hinton broth was used as nutrient medium to grow and dilute the drug suspension for the test. Inoculum size for test strain was adjust to 10^8 CFU (Colony Forming Unit) per milliliter by comparing the turbidity. DMSO was used as diluents to get desired concentration of drugs to test upon standard bacterial strains. Serial dilutions were prepared in primary and secondary screening. The control tube containing no antibiotic was immediately sub cultured (before inoculation) by spreading a loopful evenly over a quarter of plate of medium suitable for the growth of the test organism and put for incubation at 37 °C overnight. The tubes were then incubated overnight. The MIC of the control organism was read to check the accuracy of the drug concentrations. The lowest concentration inhibiting growth of the organism was recorded as the MIC. All the tubes not showing visible growth (in the same manner as control tube described above) was sub cultured and incubated overnight at 37 °C. The amount of growth from the control tube before incubation (which represents the original inoculum) was compared. Subcultures might show: similar number of colonies indicating bacteriostatic; a reduced number of colonies indicating a partial or slow bactericidal activity and no growth if the whole inoculum has been killed. The test must include a second set of the same dilutions inoculated with an organism of known sensitivity. Each synthesized drug was diluted obtaining 2000 µg/ml concentration, as a stock solution. In primary screening 500 µg/ml, 250 µg/ml and 125 µg/ml concentrations of the synthesized drugs were taken. The active synthesized drugs found in this primary screening were further tested in a second set of dilution against all microorganisms. The drugs found active in primary screening were similarly diluted to obtain 100 µg/ml, 50 µg/ml, 25 µg/ml, 12.5 µg/ml, 6.250 µg/ml, 3.125 µg/ml and 1.5625 µg/ml concentrations. The highest dilution showing at least 99 % inhibition is taken as MIC.

Conclusions

Aminosubstituted 1,3,4-oxadiazoles **4a,b** and **5a,b** exhibited very good antimicrobial activity. But when they were condensed with benzoxazinone formed oxadiazolyl-quinazolinone, showed increasing activity. Antimicrobial results were found uneven but most of the bromo and iodo derivatives of quinazolinone possessed very good antimicrobial activity. Furthermore CH_2 link between 3rd position of quinazolinone and 2nd position of oxadiazole were found most active than other two series. So, it seems from the

antimicrobial results that halogen atom and CH₂ link played vital role in increasing antimicrobial activity.

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Authors' Statement

Competing Interests

The authors declare no conflict of interest.

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