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Synthesis and characterization of 2,7-dichloro-6-fluoro-3-(((substituted) hydrazono)methyl)quinoline skeleton and their biological screening

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An efficient, simple and rapid synthesis method for the 2-chloro-5,6-dimethyl-3-(((((lower benzylidene) hydrazinylidene)methyl) quinoline is presented. Different organic compounds have been found that act as antibiotics by reacting hydrazonemethyl-7,8-dimethylquinoline with various substituted benzaldehydes in the presence of catalytic amounts of glacial acetic acid and methanol as a solvent to give desired products. Various molecules have been synthesised which act as antimicrobial agents and show moderate activity against the bacteria used.

Keywords: Antimicrobial activity, SAR study, One-pot reaction

Quinolines and their derivatives have entered the medical literature as antibacterial and antifungal agents, and new molecules of this type are constantly being studied[1]. The quinoline moiety is very important to pharmacist and chemists because it is present in a variety of naturally occurring compounds as well as useful molecules with various biological properties[2].

Quinoline and its derivatives are important in the production of natural products and medicinal products, and are also an important source of drugs in the development of new drugs (Chart 1). For this reason, many studies have made it a target molecule. Heterocyclic compounds are particularly useful due to the unique biological activities of nitrogen compounds. Besides antibiotics, quinoline compounds also have many biological activities such as vasodilatation[3], anti-malarial[4-6], anti-inflammatory[7], anti-Leishmania[8], anticonvulsant[9], anti-cancer and antioxidant[10,11], anti-tumor[12,13], antimicrobial[14,15], antihypertensive and platelet-derived growth factor receptor tyrosine kinase (PDGF-RTK) inhibitory agent[16,17], antiviral activity[18] and antiproliferative activity[19]. Here we show some best biological active molecules.

Experimental Section

For synthesis all use chemical and solvent purchased from easily available commercial vender and used it without purification. Diffusive reflectance system (DRS) was used to record IR data on a Shimadzu FT-IR-8400 sensor, and the results are provided in cm^{-1} (KBr). $CDCl_3$ chemical shifts are referenced to the solvent residual signals with respect to tetramethylsilane in the NMR spectra, which were recorded on a Bruker Avance 400 MHz spectrometer (400 MHz for ^1H NMR and 101 MHz for ^{13}C NMR, respectively). Euro EA 3000 elemental analyzer are used for the elemental analysis, melting apparatus with open capillary method used for melting point.

General synthesis procedure for compound, 1a-j

Preparation of N-(3-chloro-4-fluorophenyl)acetamide (Int-1)

A mixture of 3-chloro-4-fluoroaniline (10 mmol), acetic acid (20 mmol), acetic anhydride (10.08 mmol) are introduced in 50 mL of RBF. Reflux the reaction mixture on magnetic stirrer at 60-65°C temperature. The reaction was monitored by TLC in ethylacetate: n-hexane (1.5:8.5). After completion of the reaction, the mixture was poured in ice cold water. The precipitates were filtered and washed with distilled water for several times and recrystallized from methanol. Yield was achieved: 95%. m.p.120°C.

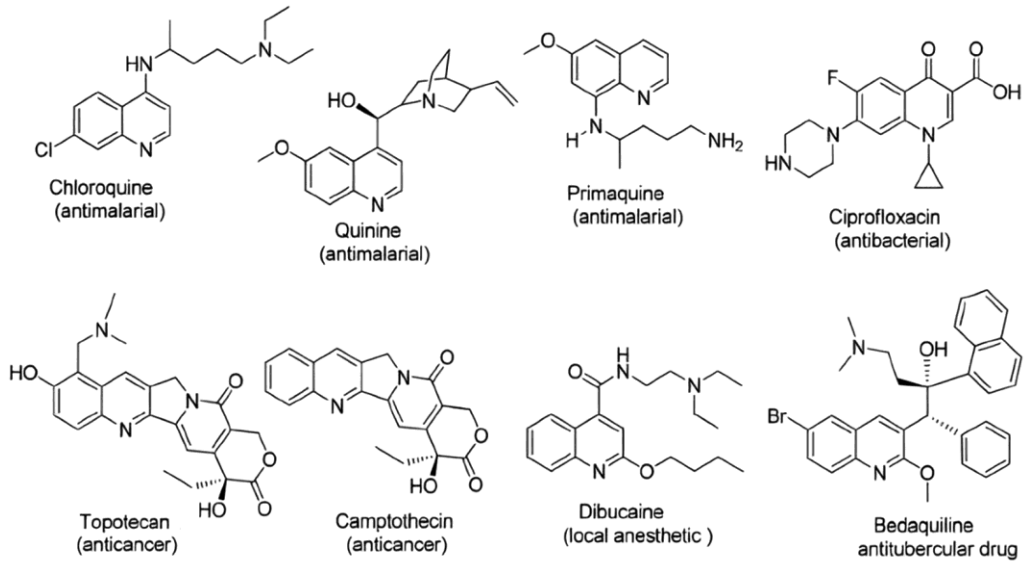


Chart 1 — Important quinoline derivatives

Preparation of 2,7-dichloro-6-fluoroquinoline-3-carbaldehyde (Int-2)

A 3-chloro-4-fluoroacetanilide(10 mmol) dissolved in DMF (dimethylformamide) (90 mmol) in 100 mL of RBF than add phosphorus oxychloride (60 mmol) at cooling condition. The reaction mixture was stirred on magnetic stirrer for few hours at 92-95℃. The reaction was monitored by TLC in ethylacetate:n-hexane (1.5:8.5). After completion of the reaction, the mixture was poured in ice cold water. The precipitates were filtered and washed with distilled water for several times and recrystallized from methanol. Yield was achieved: 92%. m.p.154°C.

Preparation of 2,7-dichloro-6-fluoro-3-(hydrazonomethyl)quinoline (Int-3)

A mixture of 2-methylbenzo[g]quinoline-3-carbaldehyde (10 mmol), hydrazine hydrate (10 mmol) and glacial acetic acid as a catalyst in 10 mL of methanol was stirred at RT for 2-2.5 h. After completion of the reaction, the mixture was poured in ice cold water. The precipitates was filtered and washed with distilled water for several times and recrystallized from methanol. Yield was achieved: 93%. m.p.142°C.

Preparation of 2,7-dichloro-6-fluoro-3-(((substituted) hydrazono)methyl)quinoline, 1a-j

A mixture of (E)-2-chloro-3-(hydrazonomethyl) benzo[g]quinoline (10 mmol), Substituted aldehyde (10 mmol) and a catalytic amount of glacial acetic acid in methanol was stirred at RT for 24 h. The precipitate was filtered and the residue washed with cold water (2×5 mL) and the solid separated was collected by filtration. It was washed with methanol, dried and recrystallized from methanol. Yield: (70%–80%).

Spectral analysis of compounds, 1a-j

2,7-Dichloro-3-(((2,5-dimethoxybenzylidene) hydrazono) methyl)-6-fluoroquinoline, 1a

IR (KBr): 3394.83, 3189.51, 3070.78, 2862.46, 2191.21, 1651.12, 1365.65, 895.00 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 7.77 (s, 1H), 7.62 (d, *J* = 8 Hz, 1H), 7.45 (d, *J* = 8.8 Hz, 1H), 7.35 (m, 1H), 7.18 (s, 1H), 1.14 (s, 2H), 6.89 (d, *J* = 8.4 Hz, 2H), 3.94 (s, 3H), 3.51 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 112.600, 118.218, 118.490, 122.975, 125.675, 126.222, 128.290, 128.662, 128.750, 130.398, 137.046, 139.459, 151.800, 156.553, 160.414, 63.027, 59.159. MS: *m/z* 406 [M]+. Anal. Calcd for: C, 56.18; H, 3.47; Cl, 17.45; F, 4.68; N, 10.34; O, 7.88. Found: C, 56.17; H, 3.46; Cl, 17.43; F, 4.70; N, 10.32; O, 7.86%. m.p.200-202°C.

2,7-Dichloro-6-fluoro-3-(((4-methylbenzylidene)-hydrazono)methyl)quinoline, 1b

IR (KBr): 3394.83, 3132.50, 3070.78, 2862.46, 2191.21, 1913.45, 1651.12, 833.28 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 7.78 (s, 1H), 7.62 (d, *J* = 8.8 Hz, 2H), 7.39 (m, 4H), 7.15 (d, *J* = 8 Hz, 2H), 3.81 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 112.694, 113.135, 118.204, 118.470, 122.995, 125.676, 125.781, 126.254, 128.759, 129.991, 139.452,

151.567, 156.587, 158.962, 160.450, 25.381. MS: *m/z* 360 [M]+. Anal. Calcd for: C, 60.02; H,3.36; Cl, 19.68; F, 5.27 N, 11.67. Found: C, 60.04; H,3.38; Cl, 19.65; F, 5.29 N, 11.68%. m.p.190-192°C.

2,7-Dichloro-3-(((3,4,5-trimethoxybenzylidene)-hydrazono)methyl)-6-fluoroquinoline, 1c

IR (KBr): 2955.04, 2839.31, 1604.83, 1519.96, 1342.50, 1319.35, 1219.05, 1041.60, 879.57, 810.13 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 9.70 (d, *J* = 99.9 Hz, 1H), 9.51 (t, *J* = 135.5 Hz, 2H), 10.41 – 8.08 (m, 3H), 10.41 – 7.38 (m, 4H), 10.41 – 7.11 (m, 5H), 10.41 – 3.85 (m, 7H), 10.41 – 0.85 (m, 16H), 10.41 – -2.02 (m, 16H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.80 (s), 154.18 (s), 153.78 (s), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 141.58 (s), 238.22 – -16.12 (m), 131.62 (d, *J* = 6.9 Hz), 130.97 (d, *J* = 3.8 Hz), 130.13 (s), 158.79 – -16.12 (m), 126.50 (d, *J* = 6.9 Hz), 124.55 (s), 122.72 (s), 122.45 (s), 118.24 (s), 117.97 (s), 106.93 (s), 60.65 (s), 56.78 (s). MS: *m/z* 406 [M]+. Anal. Calcd for: C, 55.06; H, 3.70; Cl, 16.25; F, 4.35 N, 9.63; O, 11.00. Found: C, 55.05; H, 3.68; Cl, 16.24; F, 4.37 N, 9.64; O, 11.01%. m.p.198-200°C.

2,7-Dichloro-3-(((4-fluorobenzylidene)hydrazono)-methyl)-6-fluoroquinoline, 1d

^{1}H NMR (400MHz, DMSO) δ 9.70 (d, *J* = 99.9 Hz, 1H), 9.51 (t, *J* = 135.5 Hz, 2H), 11.85 – 8.08 (m, 3H), 11.85 – 7.38 (m, 4H), 11.85 – 7.11 (m, 5H), 11.85 – 3.85 (m, 7H), 11.85 – 0.85 (m, 16H), 11.91 – -2.02 (m, 16H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.75 (s), 163.39 (s), 160.77 (s), 158.90 (s), 156.80 (s), 154.18 (s), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 131.62 (d, *J* = 6.9 Hz), 130.92 (dd, *J* = 9.5, 5.7 Hz), 130.57 (d, *J* = 3.8 Hz), 126.50 (d, *J* = 6.9 Hz), 124.55 (s), 122.72 (s), 122.45 (s), 118.24 (s), 117.97 (s), 115.63 (s), 115.36 (s). MS: *m/z* 364 [M]+. Anal. Calcd for: C, 56.07; H, 2.49; Cl, 19.47; F, 10.43 N, 11.54. Found: C, 56.06; H, 2.50; Cl, 19.45; F, 10.41 N, 11.55%. m.p.186-188°C.

4-((((2,7-Dichloro-6-fluoroquinolin-3-yl)methylene)-hydrazono)methyl)phenol, 1e

^{1}H NMR (400MHz, DMSO) δ 9.15 (s, 1H), 8.49 – 8.43 (m, 2H), 7.98 (d, *J* = 5.0 Hz, 1H), 7.43 – 7.28 (m, 3H), 6.96 (d, *J* = 7.5 Hz, 2H), 4.00 (s, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.75 (s), 159.26 (s), 158.90 (s), 156.80 (s), 154.18 (s), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 131.62 (d, *J* = 6.9 Hz), 130.97 (d, *J* = 3.8 Hz), 130.23 (s), 126.51 (d, *J* = 5.6 Hz), 124.55 (s), 122.72 (s), 122.45 (s), 118.24 (s), 117.97 (s), 115.74 (s). MS: *m/z* 362 [M]+. Anal. Calcd for: C, 56.38; H, 2.78; Cl, 19.58; F, 5.25 N, 11.60; O, 4.42. Found: C, C, 56.39; H, 2.77; Cl, 19.55; F, 5.27 N, 11.62; O, 4.43%. m.p.204-206°C.

2,7-Dichloro-6-fluoro-3-(((4-nitrobenzylidene)-hydrazono)methyl)quinoline, 1f

IR (KBr): 3101.64, 2924.18, 2854.74, 1597.11, 1597.11,1334.78 1481.38, 1172.76, 1041.60, 840.99 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 8.62 (s, 1H), 8.29 (d, *J* = 1.4 Hz, 1H), 8.15 – 8.05 (m, 3H), 8.00 (d, *J* = 5.0 Hz, 1H), 7.76 (d, *J* = 7.4 Hz, 2H), 7.30 (dd, *J* = 8.0, 1.5 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.75 (s), 158.90 (s), 156.80 (s), 154.18 (s), 149.46 (d, *J* = 3.8 Hz), 148.54 (s), 143.66 (s), 139.21 (s), 131.62 (d, *J* = 6.9 Hz), 130.97 (d, *J* = 3.δ 9.17 (s, 1H), 8.52 – 8.43 (m, 2H), 7.99 (d, *J* = 5.0 Hz, 1H), 7.44 (d, *J* = 7.4 Hz, 2H), 7.32 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.22 (d, *J* = 7.4 Hz, 2H), 2.35 (s, 3H). MS: *m/z* 391 [M]+. Anal. Calcd for: C, 52.20; H, 2.32; Cl, 18.12; F, 4.86 N, 14.32; O, 8.18. Found: C, 52.21; H, 2.33; Cl, 18.13; F, 4.87 N, 14.34; O, 8.16%. m.p.192-194°C.

2,7-Dichloro-6-fluoro-3-(((3-chlorobenzylidene)-hydra-zono)methyl)quinoline, 1g

IR (KBr): 2916.47, 2862.46, 1604.83, 1481.38, 1365.65, 1087.89, 817.85,702.11 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 9.18 (s, 1H), 8.53 (s, 1H), 8.46 (d, *J* = 1.4 Hz, 1H), 7.99 (d, *J* = 5.0 Hz, 1H), 7.76 – 7.49 (m, 1H), 7.49 – 7.28 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.11 (s), 158.90 (s), 156.80 (s), 154.18 (s), 230.01 – 133.82 (m), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 131.62 (d, *J* = 6.9 Hz), 130.97 (d, *J* = 3.8 Hz), 130.19 (s), 128.53 (s), 128.16 (s), 126.50 (d, *J* = 6.9 Hz), 125.50 (s), 124.55 (s), 122.72 (s), 122.45 (s), 118.24 (s), 117.97 (s). MS: *m/z* 380 [M]+. Anal. Calcd for: C, 53.64; H, 2.38; Cl, 27.94; F, 4.99 N, 11.04. Found: C, 53.62; H, 2.36; Cl, 27.96; F, 4.98; N, 11.05%. m.p.188-190°C.

2,7-Dichloro-3-(((3,4-dimethoxybenzylidene)-hydrazono)methyl)-6-fluoroquinoline, 1h

IR (KBr): 2939.61, 2839.31, 1589.40, 1458.23, 1126.47, 1010.73, 833.28, 779.27 cm^{-1}; ^{1}H NMR (400MHz, DMSO): δ 8.54 (s, 1H), 8.29 (d, *J* = 1.4 Hz, 1H), 8.10 (s, 1H), 7.99 (d, *J* = 5.0 Hz, 1H), 7.33 – 7.23 (m, 2H), 6.91 (dd, *J* = 7.5, 1.4 Hz, 1H), 6.84 (d, *J* = 7.5 Hz, 1H), 3.82 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.11 (s), 158.90 (s), 156.80 (s), 154.18 (s), 151.64 (s), 149.84 (s), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 131.62 (d, *J* = 6.9 Hz), 130.97 (d, *J* = 3.8 Hz), 126.97 (s), 126.50 (d, *J* = 6.9 Hz), 124.55 (s), 122.72 (s), 122.39 (d, *J* = 13.0 Hz), 118.24 (s), 117.97

(s), 113.88 (s), 110.12 (s), 56.78 (s). MS: *m/z* 406 [M]+. Anal. Calcd for: C, 56.18; H, 3.47; Cl, 17.45; F, 4.68 N, 10.34; O, 7.88. Found: C, 56.16; H, 3.45; Cl, 17.41; F, 4.69 N; 10.31; O, 7.87%. m.p.182-184°C.

2,7-Dichloro-3-(-((4-chlorobenzylidene)hydrazono)-methyl)-6-fluoroquinoline, 1i

IR (KBr): 2924.18, 2862.46, 1604.83, 1481.38, 1172.76,1087.89, 1033.88, 825.56 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 9.18 (s, 1H), 8.53 (s, 1H), 8.46 (d, *J* = 1.4 Hz, 1H), 7.99 (d, *J* = 5.0 Hz, 1H), 7.76 – 7.49 (m, 1H), 7.49 – 7.28 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.11 (s), 158.90 (s), 156.80 (s), 154.18 (s), 230.01 – 133.82 (m), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 131.62 (d, *J* = 6.9 Hz), 130.97 (d, *J* = 3.8 Hz), 130.19 (s), 128.53 (s), 128.16 (s), 126.50 (d, *J* = 6.9 Hz), 125.50 (s), 124.55 (s), 122.72 (s), 122.45 (s), 118.24 (s), 117.97 (s). MS: *m/z* 380 [M]+. Anal. Calcd for: C, 53.64; H, 2.38; Cl, 27.94; F, 4.99 N, 11.04. Found: C, 53.62; H, 2.36; Cl, 27.96; F, 4.98; N, 11.05%. m.p.190-192°C.

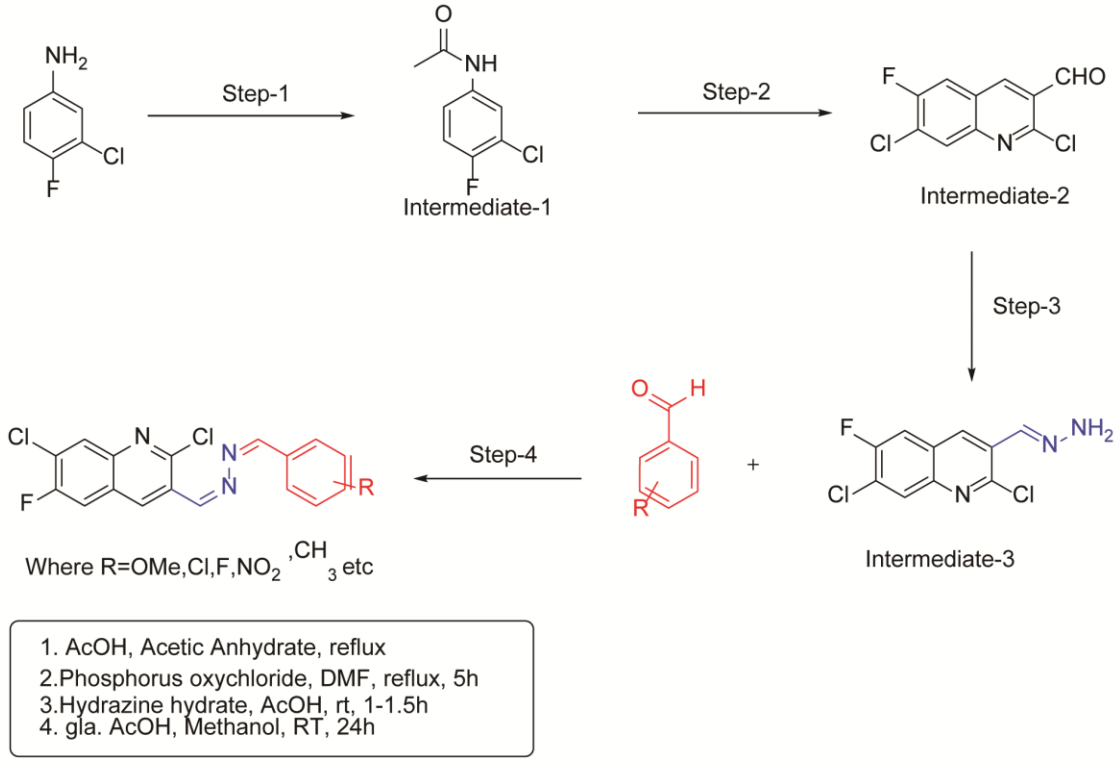
2,7-Dichloro-6-fluoro-3-(((3-bromobenzylidene)-hydrazono)methyl)quinoline, 1j

IR (KBr): 2916.47, 2862.46, 1604.83, 1481.38, 1365.65, 1087.89, 817.85, 702.11 cm^{-1}; ^{1}H NMR (400MHz, DMSO) δ 9.17 (s, 1H), 8.53 (s, 1H), 8.45 (d, *J* = 1.4 Hz, 1H), 7.99 (d, *J* = 5.0 Hz, 1H), 7.65 – 7.53 (m, 3H), 7.36 – 7.24 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.11, 158.90, 156.80 (s), 154.18 (s), 149.46 (d, *J* = 3.8 Hz), 143.66 (s), 135.75, 131.62, 130.97, 130.62, 130.26, 126.50, 126.00, 124.55, 124.28, 122.72, 122.45, 118.24, 117.97. MS: *m/z* 425 [M]+. Anal. Calcd for: C, 48.03; H,2.13; Br, 18.80; Cl, 16.68; F, 4.47 N, 9.89. Found: C, 48.02; H,2.15; Br, 18.81; Cl, 16.70; F, 4.45; N, 9.90%. m.p.186-188°C.

Results and Discussion

The results obtained are as discussed below.

By following Scheme 1, the synthesis of compounds was achieved using conventional heating techniques. The reaction was successfully executed in RBF (round bottom flask) 2,7-dichloro-6-fluoro-3-(hydrazonomethyl)quinoline and various aryl benzaldehyde. In the heating condition within a methanol solvent, this process yielded novel 2,7-dichloro-6-fluoro-3-(((substituted)hydrazono)methyl) quinoline compounds. Notably, the application of methanol solvent for the model reaction yielded remarkable yields and reaction time reduced compare to other solvent. Here we use column chromatography (60-120 mesh silica) for purification of final products



Scheme 1 — Synthetic scheme for the preparation of 2,7-dichloro-6-fluoro-3-(((substituted)hydrazono)methyl)quinoline **1a-j**

(**1a-j**) and solvent system was ethylacetate-hexane. And for characterization of the final products, we used various analytical spectroscopy techniques IR spectroscopy, mass spectroscopy, ^{1}H and ^{13}C NMR spectroscopy.

Docking Study

Molecular docking studies were performed using standard docking software AutoDock to evaluate the binding affinity and interaction profile of the synthesized 2,7-dichloro-3-((E)-(((E)benzylidene) hydrazineylidene)methyl)-6-fluoroquinoline derivatives against the selected bacterial *S. aureus* target protein (PDB ID: 2W9S). The prepared ligands were docked into the active binding pocket of the protein using a standardized docking protocol, and their binding energies were compared with that of the standard antibacterial drug ampicillin. Ampicillin exhibited a binding energy of −8.1 kcal/mol, consistent with its known antibacterial efficacy. In contrast, all quinoline derivatives demonstrated significantly lower docking scores, with binding energies below −9.0 kcal/mol, indicating stronger predicted binding affinity and enhanced stability of the ligand–protein complexes. The improved docking performance of the synthesized compounds can be attributed to the presence of the quinoline scaffold, which facilitates π–π stacking interactions, along with halogen substituents that enhance hydrophobic contacts and polar interactions within the active site. Additionally, the hydrazone linkage contributes to favorable hydrogen bonding interactions with key amino acid residues, resulting in a well-stabilized binding orientation. Compared to ampicillin, which formed fewer stabilizing interactions within the binding pocket, the quinoline derivatives exhibited a more extensive interaction network, explaining their superior docking energies. These findings suggest that the synthesized quinoline derivatives possess a higher theoretical inhibitory potential against the selected protein target and represent promising candidates for further experimental antibacterial evaluation. Upon comparison of the results, chloramphenicol, ciprofloxacin, and norfloxacin showed lower MIC values. However, when compared specifically with ampicillin, our synthesized molecules 1C, 1D, and 1H exhibited lower MIC values than the standard drug ampicillin, which can be considered a better result than the standard drug (Fig. 1, Fig. 2, Fig. 3 and Fig. 4).

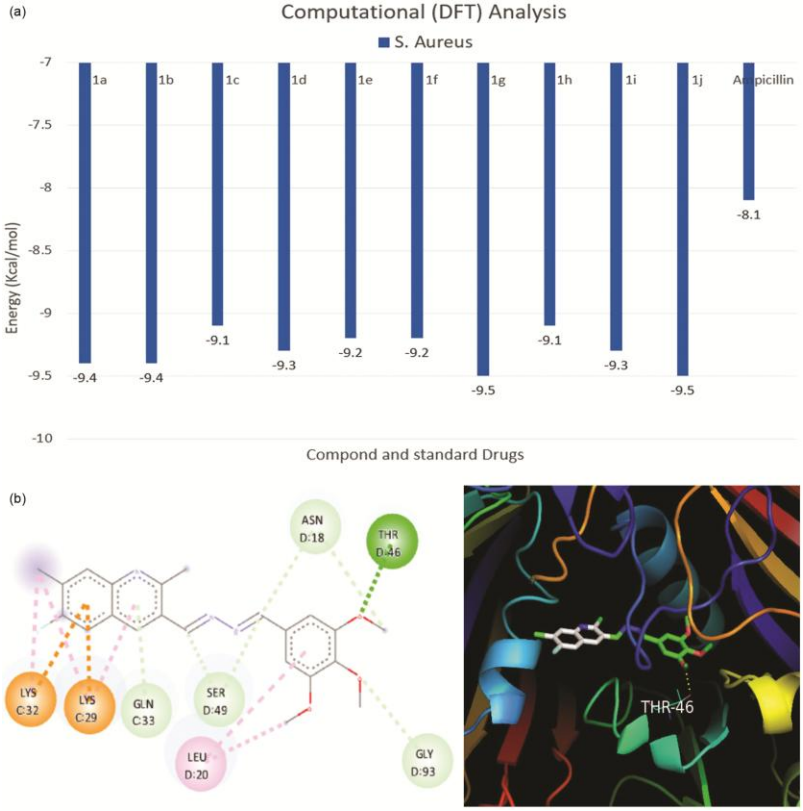


Fig. 1 — 2D and 3D interaction of compound **1c**

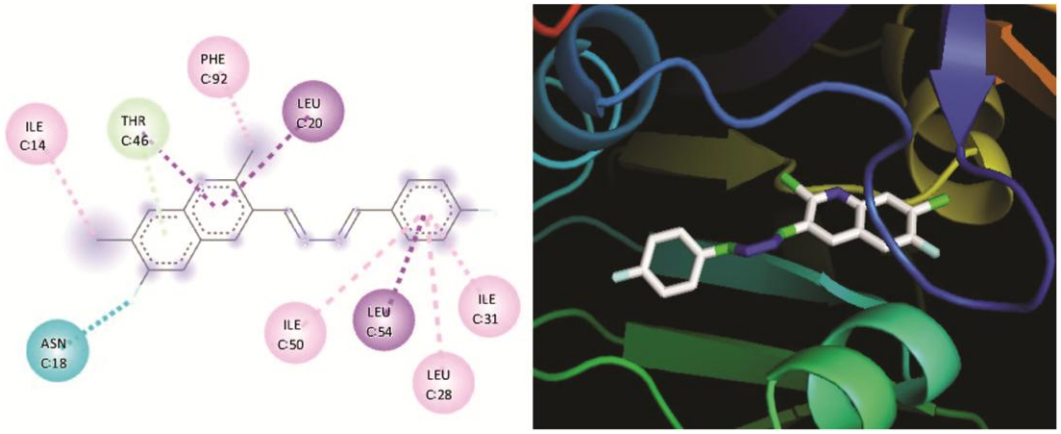


Fig. 2 — 2D and 3D interaction of compound **1d**

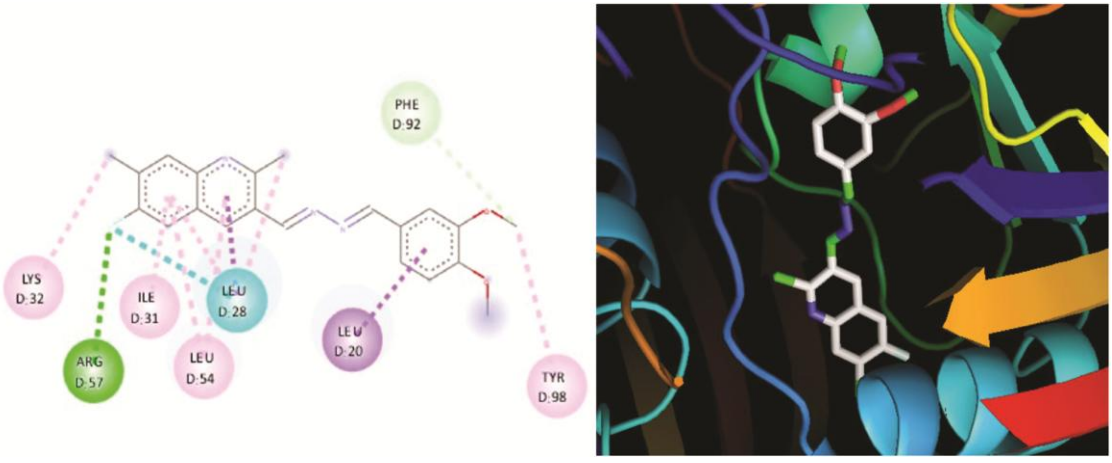


Fig. 3 — 2D and 3D interaction of compound **1h**

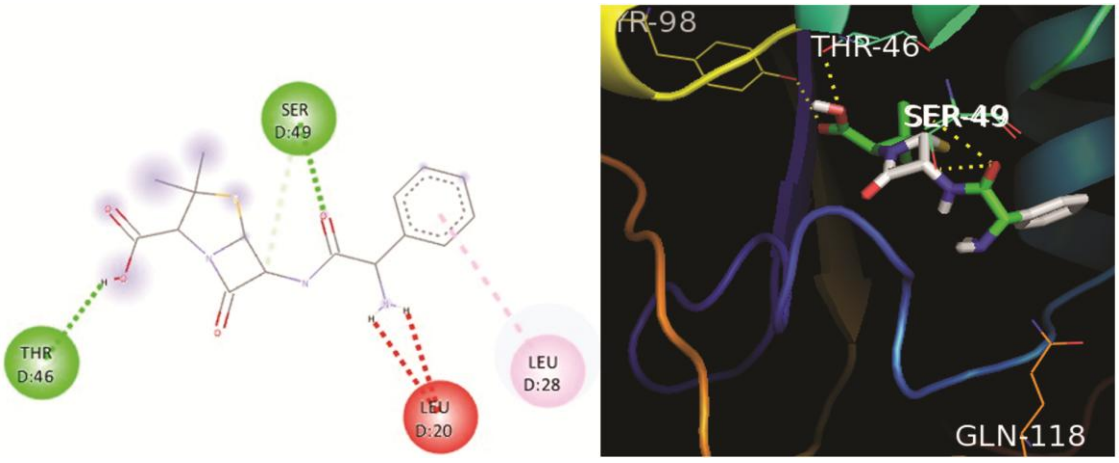


Fig. 4 — 2D and 3D interaction of compound ampicillin

Biological Evaluation

The water dilution method should be used to measure the activity of the antibiotic. It is one of the non-automated *in vitro* bacterial infections. This method shows the composition of the amount of antibiotics that should be used to inhibit the growth of certain bacteria. Antibiotics were tested against these bacteria in triplicate at different doses of 1000, 500,

Table 1 — Biological evaluation of the synthesized quinolines

S. No.	Antibacterial activity				Antifungal activity	
	Minimum inhibitory concentration µg/mL				Minimum inhibitory concentration µg/mL	
	Gram +ve Bacteria		Gram –ve Bacteria			
	B. Subtillis	*S. Aureus*	*E. Coli*	*S. Typhi*	*A. Niger*	*A. Clavatus*
1a	100	500	100	500	500	100
1b	200	200	500	100	250	500
1c	200	100	250	100	500	250
1d	500	100	500	200	200	100
1e	250	250	250	500	250	100
1f	500	500	100	250	>1000	250
1g	100	250	100	500	250	500
1h	500	100	200	200	250	500
1i	250	500	100	250	250	250
1j	500	250	250	100	100	500
A.	250	250	100	100	–	–
Cl.	50	50	50	50	–	–
C.	50	50	25	25	–	–
N.	100	10	10	10	–	–
G.	1	0.25	0.05	5	–	–
N*.	–	–	–	–	100	100
G*.	–	–	–	–	100	100

A: Ampicillin, Cl: Chloramphenicol, C: Ciprofloxacin, N: Norfloxacin G: Gentamycin, N*: Nystatin, G*: Griseofulvin

250, and 200 g/mL. Drugs showing activity in the preliminary screening are further diluted and examined. Additionally, 10µg/mL appropriate culture suspension is injected and growth is observed after one or two days. The lowest concentration of any drug that prevents bacterial growth after the incubation point is called the minimum inhibitory concentration. Ideally, the concentration of the test combination is 100 g/mL. *Bacillus subtilis* MTCC 441 and *staphylococcus aureus* MTCC 96 form gramppositive group and *escherichia coli* MTCC 443 and *salmonella typhimurium* MTCC 98 form gramnegative group of bacterial strain are required in this for testing antibacterial activity (Table 1).

The new product was subjected to six preliminary tests against A.clavatus, A.niger, at doses of 1000, 500, and 250 µg/mL to determine its antibacterial activity. A similar mixture of major elements was created in the second dilution series to create concentrations of 200 and 100 µg/mL for the second screen to be tested against all fungi. The antibacterial activity of each drug was evaluated in comparison with the drug used, nystatin, which demonstrated MICs of 100, 100, and 100 µg/mL, respectively. *Aspergillus niger* MTCC 282 and *aspergillus clavatus* MTCC 1323 must be used as fungal strains in our case study evaluation of antifungal activity (Table 1, Fig. 5).

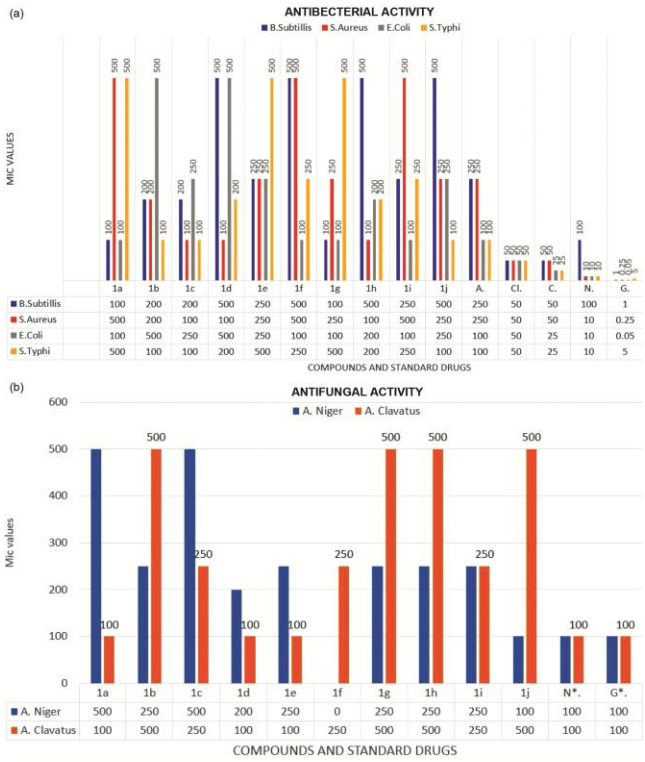


Fig. 5 — (a) Comparison antibacterial activity of all derivatives of quinoline with standard drugs and, (b) Comparison antifungal activity of all derivatives of quinoline with standard drug

Conclusion

We established a one-pot protocol to quickly and efficiently synthesis of 1a to 1j from simple starting materials. Reaction methods were optimized using methanol as solvent and molar ratios. The advantages of this reaction are increased yield for target molecules, less environmental risk, less time consumption, less cost and shorter reaction time. All synthesized compounds (1a-1j) were biotested at low dose and were found to have moderate, good, and excellent activity against bacterial and fungal species. Compounds 1a, 1b, 1c, 1d, 1f, 1g, 1h, 1i and 1j showed antibacterial activity, while compounds 1a, 1d, 1e and 1j showed antifungal activity. Figures 1a, 1d and 1j show the antibacterial and antifungal properties. Compared with examples: chloramphenicol and ampicillin, compounds 1a, 1c, 1d, 1g and 1h have excellent antibacterial properties against Gram-positive bacteria (100 μg/mL). Compared with standard nystatin and griseofulvin, compounds 1a, 1b, 1c, 1f, 1g, 1I, and 1j have strong antibacterial activity against Gram-negative bacteria (100 μg/mL). Compounds 1c and 1g showed antibacterial activity against Gram-positive and Gram-negative bacteria (100 μg/mL). Compounds 1a, 1d, 1e and 1j showed moderate antifungal properties compared to standard nystatin and griseofulvin.

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