Synthesis and antimicrobial activity of 5-aminoquinoline and 3-amino phenol derivatives

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ABSTRACT: A series of 5-aminoquinoline derivatives 3a-f and 3-aminophenol derivatives 5a-f were synthesized in order to determine their in vitro antimicrobial activity. The chemical structures of the synthesized compounds were confirmed by FT-IR and 1H NMR spectral studies. Among the synthesized compounds, 3a, 3e, 3f, 5b, 5c and 5f showed good antimicrobial activity against tested microbial strains.

KEYWORDS: 5-Aminoquinoline; 3-Aminophenol; Aldehydes; Antibacterial; Antifungal

Introduction

A Schiff base (or azomethine), named after Hugo Schiff, is a functional group that contains a carbon-nitrogen double bond with the nitrogen atom connected to an aryl or alkyl group but not hydrogen. Schiff bases derived from aromatic amines and aromatic aldehydes have a wide variety of applications in biological, inorganic and analytical chemistry [1-5]. Schiff bases possess excellent characteristics, structural similarities with natural biological substances, relatively simple preparation procedures and the synthetic flexibility that enables design of suitable structural properties [6, 7]. Antimicrobial and anticancer activities of Schiff bases have been reported [8, 9], and they are active against a wide range of organisms. Antibacterial activity has been studied more than antifungal activity, because bacteria can achieve resistance to antibiotics through biochemical and morphological modifications [10, 11]. Some Schiff bases bearing aryl groups or heterocyclic residues possess excellent biological activities have attracted the attention of many researchers in recent years [12-14]. The Schiff bases formed from aromatic aldehydes or aromatic ketones and their derivatives are quite stable. Due to the great flexibility and diverse structural aspects of Schiff bases, a wide range of these compounds have been synthesized and their activities have been studied [15, 16]. Many Schiff bases are known to be medicinally important and are used to design medicinal compounds [17].

Quinoline derivatives are used for functional materials such as fluorescence substances and for medicinal use. It is interesting that above characters change on certain chemical modification. 5-Aminoquinoline (1) is a derivative of quinoline and resembles naphthalene. It consists of one benzene ring and pyridine ring fused together. Schiff bases of 5- and 6-aminoquinolines with substituted benzaldehydes and pyridinecarbaldehydes have been reported [18]. 3-Aminophenol (4) is an aromatic amine and aromatic alcohol. Schiff bases of 2-aminophenol, 3-aminophenol and 4-aminophenol have been reported [19-21]. In connection with such studies, the present paper reports on the synthesis and antimicrobial activities of 5-aminoquinoline derivatives 3a-f and 3-aminophenol derivatives 5a-f. The synthesized compounds give significant contribution in the general area of study. Further, the study focuses on the nature of interaction and biological activity of the compounds. On the basis of their activity, the synthesized compounds were identified as viable leads for further studies.
Results and discussion
A scheme 1 and 2 illustrates the way the target compounds were prepared. The chemical structures and physical data of all the synthesized compounds are tabulated in Tables 1 and 2. The elemental analyses data showed good agreement between the experimentally determined values and the theoretically calculated values within the limits of permissible error. The melting range, yield and analytical data were depicted in Table 3.

The absorptions around 3080 cm\(^{-1}\) in synthesized compounds confirm the aromatic C-H stretching vibrations, and the appearance of a medium to strong absorption bands around 1600 cm\(^{-1}\) due to a stretching vibration of the azomethine (HC=\(\text{N}\)) bond formation in synthesized compounds [22]. The infrared spectrum shows absorption bands around 3445-3450 cm\(^{-1}\) due to OH-stretching frequency.

The proton spectral data of the key intermediate, 5-aminoquinoline (1) shows resonance at \(\delta\) 5.44 ppm (s, 2H, -NH\(_2\)). In all the synthesized compounds, (3a-f) the above resonance disappeared and additional resonances assigned to the –CH=N (\(\delta\) 8.72 – 8.62 ppm) were observed. The proton spectral data of the key intermediate, 3-aminophenol (4) shows resonance at \(\delta\) 6.40 ppm (s, 2H, -NH\(_2\)). In all the synthesized compounds, (5a-f) the above resonance disappeared and additional resonances assigned to the –CH=N (\(\delta\) 8.69 – 8.50 ppm) were observed [23].

<table>
<thead>
<tr>
<th>Compound</th>
<th>R</th>
<th>Structure</th>
<th>Mol. Formula</th>
<th>Mol. Wt.</th>
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<td>3a</td>
<td>F</td>
<td><img src="image" alt="Structure of 3a" /></td>
<td>C(<em>{16})H(</em>{10})ClFN(_2)</td>
<td>284.7</td>
</tr>
<tr>
<td>3b</td>
<td>OH</td>
<td><img src="image" alt="Structure of 3b" /></td>
<td>C(<em>{16})H(</em>{12})N(_2)O</td>
<td>248.3</td>
</tr>
<tr>
<td>3c</td>
<td>H(_3)CO</td>
<td><img src="image" alt="Structure of 3c" /></td>
<td>C(<em>{17})H(</em>{14})N(_2)O(_2)</td>
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<tr>
<td>3d</td>
<td>HO</td>
<td><img src="image" alt="Structure of 3d" /></td>
<td>C(<em>{16})H(</em>{12})N(_2)O</td>
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<tr>
<td>3e</td>
<td>C(_2)H(_5)O</td>
<td><img src="image" alt="Structure of 3e" /></td>
<td>C(<em>{18})H(</em>{16})N(_2)O</td>
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<td>3f</td>
<td>H(_3)CO</td>
<td><img src="image" alt="Structure of 3f" /></td>
<td>C(<em>{17})H(</em>{14})N(_2)O</td>
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Table 2  Chemical structures of 3-aminophenol derivatives 5a-f

<table>
<thead>
<tr>
<th>Compound</th>
<th>R Structure</th>
<th>Mol. Formula</th>
<th>Mol. Wt.</th>
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<tr>
<td>5a</td>
<td>Cl F N Cl F OH</td>
<td>C13H9ClFNO</td>
<td>249.7</td>
</tr>
<tr>
<td>5b</td>
<td>OH N OH OH</td>
<td>C13H11NO2</td>
<td>213.2</td>
</tr>
<tr>
<td>5c</td>
<td>HO H3CO N OH HO H3CO</td>
<td>C14H13NO3</td>
<td>243.2</td>
</tr>
<tr>
<td>5d</td>
<td>HO N OH HO</td>
<td>C13H11NO2</td>
<td>213.2</td>
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<tr>
<td>5e</td>
<td>C2H5O N OH C2H5O</td>
<td>C15H15NO2</td>
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</tr>
<tr>
<td>5f</td>
<td>H3CO N OH H3CO</td>
<td>C14H13NO2</td>
<td>227.2</td>
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Table 3  Melting range, yield and analytical data of 3a-f and 5a-f

<table>
<thead>
<tr>
<th>Compound</th>
<th>M.R (°C)</th>
<th>Yield (%)</th>
<th>% Analysis Found (Calculated)</th>
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<td>C</td>
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<tr>
<td>3a</td>
<td>82-84</td>
<td>62.5</td>
<td>67.53 (67.50)</td>
</tr>
<tr>
<td>3b</td>
<td>218-222</td>
<td>65.5</td>
<td>77.24 (77.40)</td>
</tr>
<tr>
<td>3c</td>
<td>88-90</td>
<td>67.3</td>
<td>73.43 (73.37)</td>
</tr>
<tr>
<td>3d</td>
<td>112-116</td>
<td>61.2</td>
<td>77.21 (77.40)</td>
</tr>
<tr>
<td>3e</td>
<td>84-86</td>
<td>66.5</td>
<td>78.47 (78.24)</td>
</tr>
<tr>
<td>3f</td>
<td>156-158</td>
<td>70.3</td>
<td>77.65 (77.84)</td>
</tr>
<tr>
<td>5a</td>
<td>158-160</td>
<td>71.7</td>
<td>73.93 (73.99)</td>
</tr>
<tr>
<td>5b</td>
<td>126-128</td>
<td>89.2</td>
<td>69.24 (69.12)</td>
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<tr>
<td>5c</td>
<td>201-203</td>
<td>84.9</td>
<td>74.48 (74.67)</td>
</tr>
<tr>
<td>5d</td>
<td>168-170</td>
<td>78.9</td>
<td>74.65 (74.67)</td>
</tr>
<tr>
<td>5e</td>
<td>108-110</td>
<td>84.8</td>
<td>73.37 (73.23)</td>
</tr>
<tr>
<td>5f</td>
<td>220-221</td>
<td>84.2</td>
<td>62.60 (62.54)</td>
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Antibacterial activity

The antibacterial activity of compounds (3a-f) were evaluated and compared with bacteriomyacin, gentamycin as standard drugs. Compounds 3a, 3e and 3f showed good antibacterial properties against bacterial strains compared with other compounds in (3a-f). Compounds 3b, 3c and 3d exhibit no inhibition against four pathogenic bacterial strains. Compound 3a exhibit no inhibition against B. Subtilis and S. Aureus. Compound 3b exhibit moderate inhibition in the range of 14 mm against E. Coli and good inhibition in the range of 20 mm against gram negative bacteria X. Campertris. Compound 3c exhibit no inhibition against E. Coli. Compound 3f exhibit good inhibition in the range of 18 mm against E. Coli and 20 mm against X. Campertris. Compound 3f exhibit no inhibition against B. Subtilis and S. Aureus. Among the compounds (3a-f) showed inhibitory activity in the order of 3e > 3f > 3a against tested bacterial strains. Compounds 5b, 5c and 5f showed good antibacterial properties against tested bacterial strains. Compounds 5a, 5d and 5e exhibit no inhibition against four pathogenic bacterial strains. Compound 5b exhibit inhibition in the range of 20 mm against gram positive bacteria S. Aureus, 20 mm against gram negative bacteria E. Coli and 22 mm against X. Campertris. Compound 5b exhibit no inhibition against gram positive bacteria B. Subtilis. Compound 3e exhibit no inhibition against B. Subtilis and S. Aureus. Compound 5e exhibit inhibition in the range of 22 mm against gram negative bacteria X. Campertris and 20 mm against E. Coli. Compound 5f exhibit inhibition in the range of 21 mm against E. Coli and 23 mm against X. Campertris. Compound 5f exhibit no inhibition against B. Subtilis and S. Aureus. Antibacterial screening results of the tested compounds are shown in Table 4.

Antifungal activity

The antifungal activity of compounds (3a-f) were evaluated and compared with nystatin as standard. The compounds 3a, 3e and 3f showed good activity against tested strain. Compounds 3b, 3c and 3d showed no inhibition against tested fungal strain. Compound 3a exhibit 58 % inhibition against F. Oxysporum. Compound 3e exhibit 68 % inhibition against tested fungal strain. Compound 3f exhibit inhibition in the range of 59 % against F. Oxysporum. Among the compounds, 3a, 3e and 3f showed inhibitory activity in the order 3e > 3f > 3a against tested fungi. Compound 5b, 5c and 5e showed moderate activity against tested fungal strain. Compounds 5a and 5d showed no inhibition against tested fungal strain. Compound 5b exhibit 55 % inhibition against F. Oxysporum. Compound 3e exhibit 50 % inhibition against tested fungal strain. Compound 5e exhibit inhibition in the range of 48 % against F. Oxysporum. Compound 5f exhibit 61 % inhibition against tested fungal strain. Among the compounds 5b, 5c, 5e and 5f showed inhibitory activity in the order 5f > 5b > 5c > 5e against tested fungi. Antifungal screening results of the tested compounds is shown in Table 4.

Table 4 In Vitro antimicrobial activities of the compounds 3a-f and 5a-f.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Zone of inhibition in diameter (mm)</th>
<th>% inhibition</th>
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<tbody>
<tr>
<td></td>
<td>E. coli</td>
<td>X. Campestris</td>
</tr>
<tr>
<td>3a</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>3b</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3c</td>
<td>-</td>
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</tr>
<tr>
<td>3d</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3e</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>3f</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>5a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5b</td>
<td>20</td>
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<td>5c</td>
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<td>-</td>
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<tr>
<td>5f</td>
<td>21</td>
<td>23</td>
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<tr>
<td>Bacteriomyacin</td>
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<td>34</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>35</td>
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<tr>
<td>Nystatin</td>
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</tbody>
</table>
Conclusions

In conclusions, Schiff bases of 5-aminoquinoline and 3-amino phenol derivatives were synthesized in good yield, characterized by different spectral studies and their antimicrobial activity have been evaluated. Compound 3e demonstrated good antibacterial and antifungal activity. Compound 5f demonstrated good antibacterial and antifungal activity compared to other compounds in 5a-f against bacterial and fungal strains tested.

Experimental

All the solvents and reagents were purchased from Sigma-Aldrich, India. Melting points were determined by Veego melting point VMP III apparatus. The FT-IR spectra were recorded using nujol mull on FT-IR Jasco 4100 infrared spectrophotometer and were quoted in cm$^{-1}$. $^1$H NMR spectra were recorded on Bruker DRX - 400 MHz spectrometer using d$_6$-DMSO as solvent and TMS as an internal standard.

General procedure for the synthesis of Schiff bases of 5-aminoquinoline with different aldehydes (3a-f)

5-Aminoquinoline (1, 0.003 mol), different aldehydes (2a-f, 0.003 mol) and 2-3 drops of concentrated sulphuric acid were refluxed for 8 hr using ethanol (10 ml). The progress of the reaction was followed by TLC until the reaction was complete. It was cooled to 0 °C, the precipitate was filtered, washed with diethyl ether and the residue was recrystallized from methanol.

Synthesis of 2-chloro-6-fluorobenzylidene-quinolin-5-yl-amine (3a)

The general experimental procedure described above afforded 3a, and the product obtained from 5-aminoquinoline (1) (0.5 g, 0.003 mol) and 2-chloro-6-fluorobenzaldehyde (2a) (0.52 g, 0.003 mol). FT-IR (KBr, cm$^{-1}$) ν: 3087 (Ar-H), 1682 (C=N), 1164 (C=O), 722 (C-Cl). $^1$H NMR (DMSO-d$_6$) δ: 9.11(s, 1H, py-H), 8.62 (s, 1H, CH=); 8.55 (d, 1H, py-H), 8.42 (d, 1H, py-H), 8.33 (d, 1H, Ar-H), 8.14 (d, 1H, Ar-H), 7.55 (t, 1H, Ar-H), 6.91-6.83 (m, 4H, Ar-H), 6.42 (s, 1H, OH).

Synthesis of 4-methoxybenzylidene-quinolina

The general experimental procedure described above afforded 3a, and the product obtained from 5-aminoquinoline (1) (0.5 g, 0.003 mol) and 4-hydroxybenzaldehyde (2d) (0.4 g, 0.003 mol). FT-IR (KBr, cm$^{-1}$) ν: 3450 (O-H), 3085 (Ar-H), 1683 (C-N), 1164 (C=O). $^1$H NMR (DMSO-d$_6$) δ: 9.12 (s, 1H, py-H), 8.64 (s, 1H, HC=N), 8.52 (d, 1H, py-H), 8.45 (d, 1H, py-H), 8.32 (d, 1H, Ar-H), 8.11(d, 1H, Ar-H), 7.55 (t, 1H, Ar-H), 7.20 (d, 2H, Ar-H), 6.93 (d, 2H, Ar-H), 6.41(s, 1H, OH).

Synthesis of 4-(quinolin-5-yl-iminomethyl)-phenol (3d)

The general experimental procedure described above afforded 3d, and the product obtained from 5-aminoquinoline (1) (0.5 g, 0.003 mol) and 4-hydroxybenzaldehyde (2d) (0.4 g, 0.003 mol). FT-IR (KBr, cm$^{-1}$) ν: 3084 (Ar-H), 1682 (C=N), 1168 (C=O). $^1$H NMR (DMSO-d$_6$) δ: 9.10 (s, 1H, py-H), 8.72 (s, 1H, Ar-H), 8.36 (d, 1H, py-H), 8.46 (d, 1H, py-H), 8.30 (d, 1H, Ar-H), 8.16 (d, 1H, Ar-H), 7.56 (d, 1H, Ar-H), 7.46 (d, 1H, Ar-H), 7.27 (d, 1H, Ar-H), 6.95 (t, 1H, Ar-H), 6.93 (d, 1H, Ar-H), 2.50-2.44 (q, 2H, CH$_2$), 2.25(t, 3H, CH$_3$).

Synthesis of 4-ethoxybenzylidene-quinolin-5-yl-amine (3c)

The general experimental procedure described above afforded 3c, and the product obtained from 5-aminoquinoline (1) (0.5 g, 0.003 mol) and 4-ethoxybenzaldehyde (2e) (0.46 ml, 0.003 mol). FT-IR (KBr, cm$^{-1}$) ν: 3082 (Ar-H), 1667 (C=N), 1167 (C-O). $^1$H NMR (DMSO-d$_6$) δ: 9.05 (s, 1H, py-H), 8.72 (s, 1H, HC=N), 8.54 (d, 1H, py-H), 8.46 (d, 1H, py-H), 8.30 (d, 1H, Ar-H), 8.16 (d, 1H, Ar-H), 7.56 (d, 1H, Ar-H), 7.46 (d, 1H, Ar-H), 7.27 (d, 1H, Ar-H), 6.95 (t, 1H, Ar-H), 6.93 (d, 1H, Ar-H), 2.50-2.44 (q, 2H, CH$_2$), 2.25(t, 3H, CH$_3$).

Synthesis of 4-methoxybenzylidene-quinolin-5-yl-amine (3f)

The general experimental procedure described above afforded 3f, and the product obtained from 5-aminoquinoline (1) (0.5 g, 0.003 mol) and 4-methoxybenzaldehyde (2f) (0.4 ml, 0.003 mol). FT-IR (KBr, cm$^{-1}$) ν: 3084 (Ar-H), 1662 (C=N), 1164 (C-O). $^1$H NMR (DMSO-d$_6$) δ: 9.12 (s, 1H, py-H), 8.65 (s, 1H, HC=N), 8.54 (d, 1H, py-H), 8.47 (d, 1H, py-H), 8.32 (d, 1H, Ar-H), 8.11(d, 1H, Ar-H), 7.56 (t, 1H, Ar-H), 7.21(d, 2H, Ar-H), 6.94 (d, 2H, Ar-H), 3.75 (s, 3H, OCH$_3$).
General procedure for the synthesis of Schiff bases of 3-aminophenol with different aldehydes (5a-f)

Equimolar concentrations of 3-aminophenol (4, 0.004 mol), different aldehydes (2a-f, 0.004 mol) and 2-3 drops of concentrated sulphuric acid were refluxed for 7 hr using methanol (10 ml). The progress of the reaction was followed by TLC until the reaction was complete. It was cooled to 0 °C, the precipitate was filtered, washed with diethyl ether and the residue was recrystallized from methanol.

Synthesis of 3-(2-chloro-6-fluorobenzylideneamino)phenol (5a)

The general experimental procedure described above afforded 5a, and the product obtained from 3-aminophenol (4) (0.5 g, 0.004 mol) and 2-chloro-6-fluorobenzaldehyde (2a) (0.72 g, 0.004 mol). FT-IR (KBr, cm⁻¹) ν: 3443 (O-H), 3052 (Ar-H), 1619 (C=O), 1304 (C-F), 1154 (C-O), 722 (C-Cl). ¹H NMR (DMSO-d₆) δ: 8.92 (s, 1H, OH), 8.69 (s, 1H, HC=N), 8.50 (d, 1H, Ar-H), 8.41(d, 1H, Ar-H), 7.52 (t, 1H, Ar-H), 7.44 (t, 1H, Ar-H), 7.37 (d, 1H, Ar-H), 7.15 (d, 1H, Ar-H), 6.78 (s, 1H, Ar-H).

Synthesis of 2-((3-hydroxyphenylimino)methyl)phenol (5b)

The general experimental procedure described above afforded 5b, and the product obtained from 3-aminophenol (4) (0.5 g, 0.004 mol) and 2-hydroxybenzaldehyde (2b) (0.49 ml, 0.004 mol). FT-IR (KBr, cm⁻¹) ν: 3451 (O-H), 3080 (Ar-H), 1690 (C=O), 1154 (C-O). ¹H NMR (DMSO-d₆) δ: 8.91(s, 1H, OH), 8.58 (s, 1H, HC=N), 8.50 -8.23 (d, 2H, Ar-H), 7.14 (t, 1H, Ar-H), 7.08 (d, 1H, Ar-H), 7.04 (d, 1H, Ar-H), 6.95 (s, 1H, Ar-H), 3.81 (q, 2H, CH₂), 1.45 (t, 3H, OCH₃).

Synthesis of 3-(4-hydroxybenzylideneamino)phenol (5c)

The general experimental procedure described above afforded 5c, and the product obtained from 3-aminophenol (4) (0.7 g, 0.004 mol) and 4-hydroxybenzaldehyde (2c) (0.56 ml, 0.004 mol). FT-IR (KBr, cm⁻¹) ν: 3463 (O-H), 3061 (Ar-H), 1686 (C=O). ¹H NMR (DMSO-d₆) δ: 8.94 (s, 1H, OH), 8.54 (s, 1H, HC=N), 8.32 (d, 1H, Ar-H), 8.25 (s, 1H, Ar-H), 7.56 (d, 1H, Ar-H), 7.44 (t, 1H, Ar-H), 7.35 (d, 1H, Ar-H), 7.15 (d, 1H, Ar-H), 6.74 (s, 1H, Ar-H), 6.45 (s, 1H, OH), 3.74 (s, 3H, OCH₃).

Synthesis of 3-(4-hydroxybenzylideneamino)phenol (5d)

The general experimental procedure described above afforded 5d, and the product obtained from 3-aminophenol (4) (0.5 g, 0.004 mol) and 4-hydroxybenzaldehyde (2d) (0.56 g, 0.004 mol). FT-IR (KBr, cm⁻¹) ν: 3463 (O-H), 3065 (Ar-H), 1691 (C=O). ¹H NMR (DMSO-d₆) δ: 8.92 (s, 1H, OH), 8.53 (s, 1H, HC=N), 8.35-8.32 (d, 2H, Ar-H), 8.26-8.23 (d, 2H, Ar-H), 7.14 (t, 1H, Ar-H), 7.08 (d, 1H, Ar-H), 7.04 (d, 1H, Ar-H), 6.95 (s, 1H, Ar-H), 6.44 (s, 1H, OH).

Synthesis of 3-(4-ethoxybenzylideneamino)phenol (5e)

The general experimental procedure described above afforded 5e, and the product obtained from 3-aminophenol (4) (0.5 g, 0.004 mol) and 4-ethoxybenzaldehyde (2e) (0.64 ml, 0.004 mol). FT-IR (KBr, cm⁻¹) ν: 3441 (O-H), 3074 (Ar-H), 1695 (C=O), 1155 (C-O). ¹H NMR (DMSO-d₆) δ: 8.92 (s, 1H, OH), 8.53 (s, 1H, HC=N), 8.35-8.32 (d, 2H, Ar-H), 8.26-8.23 (d, 2H, Ar-H), 7.14 (t, 1H, Ar-H), 7.08 (d, 1H, Ar-H), 7.04 (d, 1H, Ar-H), 6.95 (s, 1H, Ar-H), 3.81 (q, 2H, CH₂), 1.45 (t, 3H, OCH₃).

Synthesis of 3-(4-methoxybenzylideneamino)phenol (5f)

The general experimental procedure described above afforded 5f, and the product obtained from 3-aminophenol (4) (0.5 g, 0.004 mol) and 4-methoxybenzaldehyde (2f) (0.56 ml, 0.004 mol). FT-IR (KBr, cm⁻¹) ν: 3443 (O-H), 3091 (Ar-H), 1682 (C=O), 1155 (C-O). ¹H NMR (DMSO-d₆) δ: 8.90 (s, 1H, OH), 8.50 (s, 1H, HC=N), 8.34-8.30 (d, 2H, Ar-H), 8.25-8.21(d, 2H, Ar-H), 7.16 (t, 1H, Ar-H), 7.04 (d, 1H, Ar-H), 7.01(d, 1H, Ar-H), 6.96 (s, 1H, Ar-H), 3.75 (s, 3H, OCH₃).

Biological Activity

Antibacterial activity

Antibacterial activity of the synthesized compounds was determined against Gram-positive bacteria [Bacillus subtilis (Bs) MTCC 121, Staphylococcus aureus (Sa) MTCC 7443] and Gram-negative bacteria [Xanthomonas campestris (Xc) MTCC 7908 and Escherichia coli (Ec) MTCC 7410] in DMF by disc diffusion method on nutrient agar medium [24]. The sterile medium (Nutrient Agar Medium, 15 ml) in each Petri plates was uniformly smeared with cultures of Gram positive and Gram negative bacteria. Sterile discs of 10 mm diameter (Hi-Media) were made in each of the Petri plates, to which 50 µl (1 mg/ml i.e., 50 µg/disc) of the different synthesized compounds were added. The treatments also included 50 µl of DMF as negative, bacteriometin and gentamycin (1 mg/ml; 10 µg/disc) as positive control for comparison. For each treatment, three replicates were maintained. The plates were incubated at 37 ± 2 °C for 24 h and the size of the resulting zone of inhibition, if any, was determined.

Antifungal activity

The synthesized compounds were screened for their antifungal activity against Fusarium oxysporum (Fa) MTCC 2480 in DMF by poisoned food technique [25].
Potato Dextrose Agar (PDA) media was prepared and about 15 ml of PDA was poured into each Petri plate and allowed to solidify. 5 mm disc of seven days old culture of the test fungi was placed at the center of the Petri plates and incubated at 26 °C for 7 days. After incubation the percentage inhibition was measured and three replicates were maintained for each treatment. Nystatin was used as standard. All the synthesized compounds and nystatin were tested (at the dosage of 500 µl of the compounds/Petri plate, where concentration was 0.1 mg/ml) by poisoned food technique.

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References