LIST OF RESEARCH PAPERS PUBLISHED

Asian Journal of Chemistry -

1. Synthesis of 3, 5-Diaryl-4-Benzoyl-1-Pyridoyl-Δ²-Pyrazolines.


3. Studies in Co(II), Cu(II) and Ni(II) Complexes with Substituted Pyrazoline and Pyrazole at 0.1 Ionic Strength pH-metrically.
   Vol. 11, No. 2 (1999), 420-423.

4. Antimicrobial activities of 3, 5-Diaryl-4-Benzoyl-1-Pyridoyl-Δ²-Pyrazolines.
   Vol. 11, No. 3 (1999), 1064-1066.

5. Antimicrobial activities of 3, 5-Diaryl-4-Benzoyl-1-Pyridoyl Pyrazoles.
   Vol. 11, No. 3 (1999), 1077-1079.
NOTE

Synthesis of 3,5-Diaryl-4-Benzoyl-1-Pyridoyl-Δ²-Pyrazolines

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Some new 3,5-diaryl-4-benzoyl-1-pyridoyl-Δ²-pyrazolines (3) have been synthesised by the action of isoniazid on 3-aryl flavanones (2) in pyridine medium. Structures of these compounds have been established by spectral analysis (NMR, IR and UV) and elemental analysis.

The literature survey reveals the importance of chalcones and flavanones as a valuable starting materials for the synthesis of heterocycles like pyrazolines, pyrazoles and isoxazolines etc. Formation of pyrazolines has been reported by the action of hydrazines or phenyl hydrazines on chalcones and flavanones in different solvents like DMSO or ethanol, etc.

Pyrazolines were formally regarded only as an intermediate in the synthesis of pyrazoles, but these have recently come to notice for their use as effective bleaching agents, as luminescents, fluorescent and as oxidised forms in the development of cine films apart from drugs. Pyrazoline derivatives have been found to be effective insecticides, pharmaceuticals and fungicidal agents. Thus from the survey of literature it is cleared that 3,5-diaryl-4-benzoyl-1-pyridoyl-Δ²-pyrazolines are not yet synthesised. It was, therefore, thought of interest to synthesise 3,5-diaryl-4-benzoyl-1-pyridoyl-Δ²-pyrazolines (3) from 3-aryl flavanones (2).

The present work deals with the synthesis of 3,5-diaryl-1-benzoyl-1-pyridoyl-
Δ²-pyrazoline (3) from 3-aryl flavanoes (2) and isoniazide in pyridine medium. Structures of these compounds have been established by elemental analysis and spectral analysis.

Melting points are uncorrected. IR spectra in KBr were recorded on PE-983/PE-781 IR spectrophotometer, NMR in DMSO on Varian EM 390-cw NMR spectrophotometer and UV on Varian Cary 2390 UV spectrophotometer.

1) Preparation of 1,3-diaryl-1,3-propanediones (1a–1j)

2-Benzoyloxy acetophenone (0.05 mol) was dissolved in dry pyridine (40 mL) (dried over KOH). The solution was warmed up to 60°C and pulverised KOH (0.1 M) was added slowly with constant stirring. After 4 h, the reaction mixture was acidified by adding ice-cold HCl (1:1). The brownish yellow product obtained was filtered, washed with sodium bicarbonate solution (2%) and sufficient water. The product obtained was crystallised from ethanol-acetic acid mixture.

2) Preparation of 3-aryl flavanones (2a–2j)

1,3-Diaryl-1,3 propanediones (1) (0.01 M) and aromatic aldehyde (benzaldehyde and anisaldehyde) (0.01 M) were refluxed for about 1 h in ethanol (25 mL) containing a few drops of piperidine. The reaction mixture was cooled and the product separated was crystallised from ethanol-acetic acid mixture.

Spectral interpretation of 2d

IR (νmax) : 1625 cm⁻¹ ν(C=O); 1600 cm⁻¹ ν(C=O) (two C=O groups); 552 cm⁻¹ ν(C=Br); 1235 ν(C—O—C).

NMR : δ 2.32 (S, 3H, Ar—CH,); 3.73 (S, 3H, O—CH₃); 5.04 (d, 1H); 5.91 (d, 1H); 6.3–7.8 (m, 10H, Ar—H).

UV (λmax) : 340 nm.

3) Preparation of 3,5-diaryl-4-benzoyl-1-pyridoyl-Δ²-pyrazolines (3a–3j)

3-Aroyl flavanones (2a–j) (0.1 M) were refluxed with isoniazide (0.2 M) for 8–10 h. in pyridine solvent. The reaction was decomposed by acidified water, filtered and washed with sufficient water. It was crystallised from ethanol-acetic acid mixture to obtain a white crystalline solid. Yield 60–80%.

Spectral interpretation of 3d

IR (νmax) : 3400 cm⁻¹ ν(C—OH); 550 cm⁻¹ ν(C—Br); 1550 cm⁻¹ ν(C==N); 1200 cm⁻¹ ν(C==N); 1150 cm⁻¹ ν(C—O).

NMR : δ 2.4 (S, 3H, —CH₃); 3.6 (d, 1H, —CH); 6.8 (d, 1H, —CH); 8 to 8.5 (m, 17H, Ar—H); 11.8 (S, 1H, —OH).

UV (λmax) : 280 nm

Physical data of series (3a–3j) were recorded in Table 1.
TABLE-I

PHYSICAL CHARACTERISATION DATA OF SYNTHESISED COMPOUNDS
3,5-Diaryl-4-benzoyl-1-pyridoyl-\(\Delta^2\)-pyrazoline (3a–3j)

<table>
<thead>
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<th>Compound</th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
<th>R₅</th>
<th>Yield (°C)</th>
<th>m.p. (°C)</th>
<th>Molecular formula</th>
<th>% N, found (calcd.)</th>
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<td>H</td>
<td>CH₃</td>
<td>H</td>
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<td>67</td>
<td>250</td>
<td>C₂₉H₂₃O₃N₃</td>
<td>8.5 (9.1)</td>
</tr>
<tr>
<td>3b</td>
<td>H</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
<td>70</td>
<td>215</td>
<td>C₃₀H₂₅O₄N₃</td>
<td>7.8 (8.5)</td>
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<td>237</td>
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</tr>
<tr>
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<td>H</td>
<td>OCH₃</td>
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<td>8.3 (7.3)</td>
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<tr>
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<td>CH₃</td>
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<td>H</td>
<td>70</td>
<td>236</td>
<td>C₂₉H₂₃O₃N₃</td>
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<td>OCH₃</td>
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<td>H</td>
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<td>215</td>
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<td>8.9 (9.3)</td>
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<td>210</td>
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REFERENCES


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Synthesis and Characterization of 3,5-Diaryl-4-Benzoyl-1-Pyridoyl Pyrazoles

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Some new 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles have been synthesised by the action of isoniazid on 3-aroyl flavones in pyridine medium. Structures of these compounds have been established by spectral analysis (NMR, IR and UV) and elemental analysis.

INTRODUCTION

The literature survey reveals the importance of chalcones and flavanones as a valuable starting materials for the synthesis of heterocycles like pyrazolines, pyrazoles isoxazolines etc. Formation of pyrazoles has been reported by the action of hydrazines or phenyl hydrazines on flavones and chalcones in different solvents like methanol, DMSO, acetic acid, etc. Pyrazole is a class of compounds which are widely useful in drugs and dyes. These compounds also show physiological activities. Trifluoromethyl-1-aryl derivatives of pyrazoles are used as analgesic, antipyretic and antiinflammatory agents. 1-phenyl derivatives are effective antidiabetics. Acyl amino and chloro pyrazoles have been found to be effective herbicides. Phenyl pyrazoles act as insecticides and alkyl pyrazoles are also used as hypolipidemic agents.

The literature survey clearly indicates that 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles are not yet synthesised. It was, therefore, thought of interest to synthesise 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles (4) from 3-aroyl flavones (3). Thus present work deals with the synthesis of some new 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles (4) from 3-aroyl flavones (3) (Scheme-I) and isoniazid in pyridine medium. Structures of these compounds have been established by elemental analysis and spectral analysis.

EXPERIMENTAL

Melting points are uncorrected. IR spectra in KBr were recorded on PE-983/PE-781 IR spectrophotometer. NMR in DMSO on Varian EM 390-cw NMR spectrophotometer and UV on Varian Cary 239 OUV spectrophotometer.

(1) Preparation of 1,3-diaryl-1,3-propanedione (1a–1j)—2-Benzoyloxy acetophenone (0.05 M) was dissolved in dry pyridine (40 mL) (dried over KOH). The solution was warmed up to 60°C and pulverised KOH (0.1 M) was added slowly with constant stirring. After about 4 h, the reaction mixture was acidified
by adding ice-cold HCl (1:1). The brownish yellow product obtained was filtered, washed with sodium bicarbonate solution (2%) and sufficient water. The product obtained was crystallised from ethanol-acetic acid mixture.

(2) Preparation of 3-arylated flavanones (2a–2j): 1,3-Diaryl-1,3-propanediones (1) (0.01 M) and aromatic aldehyde (benzaldehyde and anisaldehyde) (0.01 M) were refluxed for about 1 h in ethanol (25 mL) containing a few drops of piperidine. The reaction mixture was cooled and the product separated was crystallised from ethanol-acetic acid mixture. The structures of these compounds are confirmed by spectral analysis.

(3) Preparation of 3-arylated flavones (3a–3f): 3-Aroylated flavanones (2a–j) (0.01 M) and SeO₂ (0.001 M) were refluxed in dioxane for about 18 h. The reaction mixture was poured in cold water through a funnel fitted with glass wool. The solid separated was filtered, washed with sodium thiosulphate (5%) and water. It was recrystallised from ethanol-acetic acid mixture. Yield 80 to 95%.

Spectral interpretation of 3a:
IR (νmax) 1650 cm⁻¹ v(C=O); 1615 cm⁻¹ v(C=O); 1590–1585 cm⁻¹ v(C=C); 1245 cm⁻¹ v(C–O–C).
¹H NMR: δ 2.30 (S. 3H, Ar—CH₃); 3.80 (S, 3H, Ar—O); 6.7–8.3 (m, 11H, Ar–H).
UV (λmax) 322 nm.

Physical data of the series (3a–3j) were recorded in Table-1.
TABLE-1
PHYSICAL CHARACTERISATION DATA OF SYNTHESISED COMPOUNDS
3-Aroyl Flavones (3a-3j)

<table>
<thead>
<tr>
<th>Compound</th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
<th>R₅</th>
<th>Yield (°C)</th>
<th>m.p. (°C)</th>
<th>Molecular formula</th>
</tr>
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<td>H</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>85</td>
<td>132</td>
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</tr>
<tr>
<td>3b</td>
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<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
<td>85</td>
<td>156</td>
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<tr>
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<td>H</td>
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<td>152</td>
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<td>148</td>
<td>C₂₃H₁₆O₃</td>
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<td>H</td>
<td>OCH₃</td>
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<td>H</td>
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<td>145</td>
<td>C₂₂H₁₄O₃</td>
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<tr>
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<td>OCH₃</td>
<td>80</td>
<td>185</td>
<td>C₂₃H₁₆O₄</td>
</tr>
</tbody>
</table>

(4) Preparation of 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles (4a-4j):
3-Aroyl flavones (3a-j) (0.01 M) were refluxed with isoniazide (0.2 M) for 8–10 h in pyridine solvent. The reaction mixture was decomposed by acidified water, filtered and washed with sufficient water. It was recrystallised from ethanol-acetic acid mixture to obtain a white crystalline solid. Yield 60–80%.

Spectral interpretation of 4a:
IR (v max) 1625 cm⁻¹ v(C=O); 3350 cm⁻¹ v(OH); 1620 cm⁻¹ v(C=N); 1500 cm⁻¹ v(C=C); 1390 cm⁻¹ v(C—N); 1035 cm⁻¹ v(C—O) (phenol).
NMR: δ 1.9 (S, 3H, —CH₃); 7.2–7.6 (m, 17H, Ar—H); 12 (S, 1H, —OH).
UV (λ max) 256 nm.
Physical data of series (4a–4j) were recorded in Table-2.

TABLE-2
PHYSICAL CHARACTERISATION DATA OF SYNTHESISED COMPOUNDS
3,5-Diaryl-4-Benzoyl-1-Pyridoyl Pyrazoles (4a–4j)

<table>
<thead>
<tr>
<th>Compound</th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
<th>R₅</th>
<th>Yield (°C)</th>
<th>m.p. (°C)</th>
<th>Molecular formula</th>
<th>N % found (calc)</th>
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<td>252</td>
<td>C₂₃H₂₁O₃N₃</td>
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<tr>
<td>4b</td>
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<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
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<td>232</td>
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<td>H</td>
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REFERENCES


(Received: 4 November 1997; Accepted: 29 December 1997) AJC-1424
Studies in Co(II), Cu(II) and Ni(II) Complexes with Substituted Pyrazoline and Pyrazole at 0.1 Ionic Strength pH-metrically

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Department of Chemistry
Amravati University
Amravati-444 602, India

The interaction of Co(II), Cu(II) and Ni(II) with 3-(2-hydroxy-5-methyl phenyl)-4-benzoyl-5-phenyl-1-pyridoyl-Δ^2-pyrazoline and 3-(2-hydroxy-3-bromo-5-methyl phenyl)-4-benzoyl-5-(4-methoxy phenyl)-1-pyridoyl pyrazole have been investigated by Bjerum method as adopted by Calvin and Wilson. The stability constants of 1 : 1 and 1 : 2 complexes of Co(II), Cu(II) and Ni(II) have been studied at constant temperature (27 ± 0.1°C) and 0.1 M ionic strength (NaOH) in 70% DMF-water mixture. It is observed that formation of 1 : 1 and 1 : 2 complexes is occurring simultaneously.

INTRODUCTION

Metal chelates of 3-(o-hydroxyphenyl)-5-phenyl isoxazole with Be(II), Mn(II), Co(II), Ni(II), Cu(II), Zn(II), Cd(II) and UO_2(VI) have been investigated by Vithalrao et al. The spectral properties of 3-(o-hydroxy phenyl)-5-phenyl isoxazole were reported by Murthy et al. Metal ligand stability constants of lanthanides with some substituted pyrazolines and diketones are studied by Sawalakhe and Narwade. Mandakmare et al. have studied the metal-ligand stability constant of Cu(II) with some substituted coumarins pH-metrically in 70% dioxane-water mixture. Sondawale et al. have determined metal-ligand stability constants and adiabatic compressibility of Cu(II)-peptide complexes recently. Gudadhe et al. have performed the study of stability constants of Th(IV) complexes with some substituted pyrazolines.

In view of the analytical applications of pyrazolines and pyrazoles, it is of interest to study the physico-chemical properties such as stability constants of Co(II), Cu(II) and Ni(II) complexes with 3-(2-hydroxy-5-methyl phenyl)-4-benzoyl-5-phenyl-1-pyridoyl-Δ^2-pyrazoline and 3-(2-hydroxy-3-bromo-5-methyl phenyl)-4-benzoyl-5-(4-methoxy phenyl)-1-pyridoyl pyrazole. In the present investigation 70% DMF-water mixture is used as a solvent for preparation of solution.
Ligand-1

Ligand-2

EXPERIMENTAL

All chemicals such as sodium hydroxide, nitric acid, potassium nitrate and metal salts of AnalaR grade were used in the present investigation.

3-(2-Hydroxy-5-methyl phenyl)-4-benzoyl-5-phenyl-1-pyridoyl-Δ²-pyrazoline (ligand-1) and 3-(2-hydroxy-3-bromo-5-methyl phenyl)-4-benzoyl-5-(4-methoxy phenyl)-1-pyridoyl pyrazole (ligand-2) were prepared by following literature method. Both ligands were crystallized and their purity was checked by TLC before use. The solutions of purified ligands were prepared in DMF and standardised by potentiometric techniques.

ELICO pH-meter model LI-10 (accuracy ± 0.05 unit) with a glass electrode and saturated calomel electrode was used for the measurement of pH. It was calibrated by buffer of pH 4.0, 7.0 and 9.2 at 27°C before proceeding for titrations.

The experimental procedure involved pH-metric titrations of (i) free acid (0.01 M) (ii) free acid (0.01 M) and ligand (20 x 10⁻⁴ M) and (iii) free acid (0.01 M) + ligand (20 x 10⁻⁴ M) + metal ion (4 x 10⁻⁴ M) against standard NaOH solution. The ionic strength of all the solutions was maintained constant (0.1 M) by adding an appropriate quantity of 1 M potassium nitrate.

The titrations were carried out in 100 mL pyrex glass beaker kept in a water bath maintained at constant temperature (27 ± 0.1°C). Nitrogen gas was slowly bubbled through the solution to remove the oxygen and carbon dioxide. The pH-meter readings were taken only after the gas bubbling was completely stopped. In aqueous-organic mixture pH values were corrected by use of Van-UTERT and Hass equation.
RESULTS AND DISCUSSION

Proton-ligand formation constants: The deviation of acid-ligand curves from acid curves started around pH = 5.70 for both ligands and increased continuously up to pH 12.0. It shows that dissociation of —OH group occurs which is present in the ligand part of the complex structure. The values of $n_A$ were calculated by Irving-Rossotti’s expression. The pKa values for both systems were calculated by half integral and pointwise calculations which are presented in Table-1.

<table>
<thead>
<tr>
<th>TABLE-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. No.</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. No.</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
</tr>
<tr>
<td>6.</td>
</tr>
</tbody>
</table>

Metal-ligand stability constants: The values of $n_A$ were evaluated from Irving-Rossotti’s expression which were used to calculate the metal-ligand stability constants. The metal-ligand stability constants for all the systems were calculated by half integral and pointwise calculation methods. These values are presented in Table-2. It could be seen from Table-2 that there is no differences
as such between the log K values for both the complexes. It showed that there must be simultaneously complex formations and not stepwise formation. The order of stability of metal-ligand complexes is Co(II) > Cu(II) > Ni(II) for pyrazoline ligand and Co(II) < Cu(II) < Ni(II) for pyrazole ligand. The lesser values of log K in case of pyrazole may be due to the presence of bromine atom as an electron withdrawing group.

REFERENCES


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NOTE

Antibacterial Activities of 3,5-Diaryl-4-Benzoyl-1-Pyridoyl-$\Delta^2$-Pyrazolines

M.V. KADU*, V.S. JAMODE and D.H. TAMBEKARI†
Post Graduate Department of Chemistry
Amravati University, Amravati-444 602, India

3,5-Diaryl-4-benzoyl-1-pyridoyl-$\Delta^2$-pyrazolines have been synthesised from 3-aryl flavanones and isoniazide in pyridine medium. Structures of these compounds have been characterised by spectral analysis. These compounds were tested for their antibacterial activities against pathogenic bacteria and are found to have remarkable activity.

From the survey of literature pyrazolines have been found to be effective insecticides$^{1-3}$, antinflammatory$^4$, bacterial$^{5-8}$, pharmaceutical$^9$, fungicidal$^{5,10,11}$ and herbicidal agents$^{12}$.

The present work deals with the study of antibacterial activities of 3,5-diaryl-4-benzoyl-1-pyridoyl-$\Delta^2$-pyrazolines (3a–j). These compounds were tested against P. aeruginosa, S. aureus, C. freundii, E. coli, P. mirabilis, B. megatherium and S. typhi. Some of them were found to be highly active against microbes.

Melting points were uncorrected. The structures of these compounds were established on the basis of their elemental analysis and spectral data. Preparation and characterization of 3,5-diaryl-4-benzoyl-1-pyridoyl-$\Delta^2$-pyrazolines (3a–j) are already reported$^{13}$ (Physical data of pyrazolines (3a–j) is recorded in Table-1.)

TABLE-1

<table>
<thead>
<tr>
<th>Compounds</th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
<th>R₅</th>
<th>m.p. (°C)</th>
<th>m.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a</td>
<td>H</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>250</td>
<td>C₂₉H₂₂O₄N₃</td>
</tr>
<tr>
<td>3b</td>
<td>H</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
<td>215</td>
<td>C₃₀H₂₄O₄N₃</td>
</tr>
<tr>
<td>3c</td>
<td>Br</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>237</td>
<td>C₂₉H₂₂O₃N₃Br</td>
</tr>
<tr>
<td>3d</td>
<td>Br</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
<td>227</td>
<td>C₃₀H₂₄O₄N₃Br</td>
</tr>
<tr>
<td>3e</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>256</td>
<td>C₂₉H₂₃O₃N₃</td>
</tr>
<tr>
<td>3f</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>OCH₃</td>
<td>225</td>
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</tr>
<tr>
<td>3g</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>236</td>
<td>C₂₉H₂₃O₃N₃</td>
</tr>
<tr>
<td>3h</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>OCH₃</td>
<td>214</td>
<td>C₃₀H₂₅O₄N₃</td>
</tr>
<tr>
<td>3i</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>215</td>
<td>C₂₈H₂₁O₃N₃</td>
</tr>
<tr>
<td>3j</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>OCH₃</td>
<td>210</td>
<td>C₂₉H₂₃O₄N₃</td>
</tr>
</tbody>
</table>

†Post Graduate Department of Microbiology, Amravati University, Amravati-444 602, India
Antibacterial activity

The titled compounds were screened for their antibacterial activities using bacteria *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Citrobacter freundii*, *Escherichia coli*, *Proteus mirabilis*, *Bacillus megatherium* and *Salmonella typhi* by paper disc method at a concentration of 50 μg/2 mL using DMF as a solvent. After 24 h of inhibition at 37°C the zones of inhibition are measured in mm and are recorded in Table-2.

<table>
<thead>
<tr>
<th>TABLE-2</th>
<th>ANTIBACTERIAL ACTIVITY OF COMPOUNDS NOS. 3a-j</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone of inhibition in mm</td>
<td></td>
</tr>
<tr>
<td>Organism</td>
<td>3a</td>
</tr>
<tr>
<td><em>P. aeruginosa</em></td>
<td>—</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>8</td>
</tr>
<tr>
<td><em>C. freundii</em></td>
<td>8</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>—</td>
</tr>
<tr>
<td><em>P. mirabilis</em></td>
<td>6</td>
</tr>
<tr>
<td><em>B. megatherium</em></td>
<td>7</td>
</tr>
<tr>
<td><em>S. typhi</em></td>
<td>6</td>
</tr>
</tbody>
</table>

Strongly active range: > 12 mm; Moderately active range: 8–12 mm; Weakly active range: < 8 mm; Inactive.

In case of antibacterial activities from Table-2 it has been observed that all compounds (3a–j) were inactive against *P. aeruginosa*.

The compound 3a showed moderate activities against *S. aureus* and *C. freundii* and weak activity against *P. mirabilis, B. megatherium* and *S. typhi*.

The compound 3b showed weak activities towards *S. aureus*, *C. freundii* and *S. typhi*.

The compound 3c showed moderate activities against *B. megatherium* and *S. typhi* and was weakly active against *S. aureus*, *C. freundii* and *P. mirabilis*.

The compound 3d showed moderate activities towards *E. coli*, *P. mirabilis*, *B. megatherium* and *S. typhi* and was weakly active against *S. aureus* and *C. freundii*.

The compound 3e showed weak activities against *E. coli*, *P. mirabilis*, and *B. megatherium*.

The compound 3f was inactive against all the organisms.

The compound 3g was moderately active only against *C. freundii*.

The compound 3h was moderately active against *C. freundii* and weakly active against *S. typhi*.

The compound 3i showed moderate activities against *C. freundii*, *E. coli*, *B. megatherium* and *S. typhi*, while weak activity against *A. aureus*.

The compound 3j was moderately active against *C. freundii* and showed weak activities against *S. aureus*, *E. coli* and *P. mirabilis*.

Bromo substituted pyrazolines (3c) and (3d) are more active towards each
micro organism as compared to other pyrazolines. This may be due to the presence of bromine atom in the structure of pyrazolines.

ACKNOWLEDGEMENT

The authors are thankful to Miss S.N. Bhure and Miss N.M. Pathak, Microbiology Department, Amravati University, Amravati for providing facilities for testing the compounds against pathogenic bacteria and for their kind co-operation.

REFERENCES


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NOTE

Antibacterial Studies of 3,5-Diaryl-4-Benzoyl-1-Pyridoyl Pyrazoles

M.V. KADU* and V.S. JAMODE
Post-Graduate Department of Chemistry
Amravati University
Amravati-444 602, India

3,5-Diaryl-4-benzoyl-1-pyridoyl pyrazoles (4a-j) had been synthesized from 3-aryl flavones and isoniazide in pyridine medium. Structures of these compounds have been confirmed by spectral analysis. These compounds were tested for their antibacterial activities against pathogenic bacteria and are found to have moderate activity.

The survey of literature reveals that 3,5-diaryl pyrazoles possess diverse biological activities. It has been reported that pyrazoles possess pharmacological, anticancer, fungicidal, herbicidal, and anti-bacterial activities. They are also found to be antidiabetic, pesticidal, anti-inflammatory, and hypolipidemic agents.

Pyrazoles have also been found to possess antiparasitic and effective insecticides.

The present work deals with the study of antibacterial activities 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles. These compounds were tested against P. aeruginosa, S. aureus, C. freundii, E. coli, P. mirabilis, B. megatherium, and S. typhi. Some of them were found to be highly active against these organisms.

Melting points were uncorrected. The structures of these compounds were established on the basis of their elemental analysis and spectral data. Preparation and characterization of 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazoles (4a-j) are already reported. (Physical data of pyrazoles (4a-j) is recorded in Table-1.)

Antibacterial activity

The titled compounds were tested against pathogenic bacteria for their antibacterial activity by paper disc method. The organisms tested were P. aeruginosa, S. aureus, C. freundii, E. coli, P. mirabilis, B. megatherium, and S. typhi. The solution of these compounds were prepared in DMF as a solvent at a concentration of 50 μg/2 mL. The culture medium used was nutrient agar medium. After 24 h of inhibition at 37°C, the zones of inhibition were measured in mm and are recorded in Table-2.

In case of antibacterial activity from Table-2 it has been observed that the compound 4a showed strong activities against P. mirabilis and B. megatherium, moderate activities against C. freundii, E. coli and S. typhi and was weakly active against P. aeruginosa.
The compound 4b was strongly active against *B. megatherium*, moderately active against *E. coli* and *S. typhi* and showed weak activities against *S. aureus* and *C. frundii*.

The compound 4c showed strong activities against *S. typhi* and *B. megatherium*, moderate activity towards *E. coli* and *P. mirabilis* and weak activity against *S. aureus* and *C. frundii*.

The compound 4d showed activities against all the organisms. It was moderately active against *E. coli*, *P. mirabilis*, *B. megatherium* and *S. typhi* and was weakly active against *P. aeruginosa*, *S. aureus* and *C. frundii*.

The compound 4e was moderately active against *C. frundii*, *E. coli*, *B. megatherium* and *S. typhi*.

The compound 4f showed moderate activities against *C. frundii* and *E. coli* only.

The compound 4g showed moderate activities towards *E. coli* and *B. megatherium*. 

### TABLE-1
PHYSICAL DATA OF PYRAZOLE (4a–j)

<table>
<thead>
<tr>
<th>Compounds</th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
<th>R₅</th>
<th>m.p. (°C)</th>
<th>m.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a</td>
<td>H</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>252</td>
<td>C₂₉H₂₁O₂N₃</td>
</tr>
<tr>
<td>4b</td>
<td>H</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
<td>232</td>
<td>C₂₉H₂₁O₂N₂Br</td>
</tr>
<tr>
<td>4c</td>
<td>Br</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>215</td>
<td>C₂₉H₂₀O₂N₂Br</td>
</tr>
<tr>
<td>4d</td>
<td>Br</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>OCH₃</td>
<td>245</td>
<td>C₂₉H₂₂O₂N₂Br</td>
</tr>
<tr>
<td>4e</td>
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<td>H</td>
<td>H</td>
<td>270</td>
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</tr>
<tr>
<td>4f</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>OCH₃</td>
<td>231</td>
<td>C₂₉H₂₂O₂N₃</td>
</tr>
<tr>
<td>4g</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>240</td>
<td>C₂₉H₂₂O₃N₃</td>
</tr>
<tr>
<td>4h</td>
<td>H</td>
<td>CH₃</td>
<td>H</td>
<td>H</td>
<td>OCH₃</td>
<td>234</td>
<td>C₂₉H₂₂O₂N₃</td>
</tr>
<tr>
<td>4i</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>215</td>
<td>C₂₉H₁₉O₂N₃</td>
</tr>
<tr>
<td>4j</td>
<td>H</td>
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<td>H</td>
<td>H</td>
<td>OCH₃</td>
<td>210</td>
<td>C₂₉H₂₂O₂N₄</td>
</tr>
</tbody>
</table>

### TABLE-2
ANTIBACTERIAL ACTIVITY OF COMPOUNDS NOS. (4a–j)

<table>
<thead>
<tr>
<th>Organism</th>
<th>4a</th>
<th>4b</th>
<th>4c</th>
<th>4d</th>
<th>4e</th>
<th>4f</th>
<th>4g</th>
<th>4h</th>
<th>4i</th>
<th>4j</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. aeruginosa</em></td>
<td>7</td>
<td>—</td>
<td>6</td>
<td>6</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>—</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>C. frundii</em></td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>—</td>
<td>7</td>
<td>6</td>
<td>—</td>
<td>—</td>
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<tr>
<td><em>E. coli</em></td>
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<td>8</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>7</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><em>P. mirabilis</em></td>
<td>15</td>
<td>—</td>
<td>10</td>
<td>10</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td><em>B. megatherium</em></td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>12</td>
<td>9</td>
<td>—</td>
<td>7</td>
<td>—</td>
<td>—</td>
<td>7</td>
</tr>
<tr>
<td><em>S. typhi</em></td>
<td>10</td>
<td>12</td>
<td>18</td>
<td>9</td>
<td>9</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>8</td>
</tr>
</tbody>
</table>

strongly active range: >12 mm, moderately active range: 8–12 mm, weakly active range: <8 mm, inactive —
The compound 4h showed no activities against all the organisms.

The compound 4i was weakly active only against C. freundii.

The compound 4j was moderately active to S. typhi and showed weak activities towards C. freundii, P. mirabilis and B. megatherium.

Bromo-substituted pyrazole (4c) and (4d) are more active towards each microorganism as compared to other pyrazoles. This may be due to the presence of bromine atom in the structure of pyrazoles.

REFERENCES

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