Note

Scope of mercuric acetate oxidation of chalcones and the antibacterial activity of resulting aurones

M S Y Khan* & M Asad Muheed

Department of Pharmaceutical Chemistry, Jamia Hamdard, New Delhi 110 062, India
E-mail: mspykhan@hotmail.com

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Mercuric acetate provides a convenient reagent for oxidative cyclization of 2'-hydroxychalcones resulting in stereospecific formation of Z-aurones. Thirteen aurones have been synthesised with varying substituents for studying the scope of the reaction. The antibacterial activity of these products has been studied against Staphylococcus aureus and Escherichia coli.

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Mercuric acetate is well known for highly regioselective and stereospecific oxymercuration of olefines. Other uses of mercuric acetate, to quote a few, include oxidative cyclization of dienes, oxidation of piperidines to piperidones, synthesis of tetrahydrofuran and tetrahydropryan from the corresponding unsaturated alcohols, it can also methoxylate allylic positions when used in methanol. A report recommends use of mercuric acetate for oxidative cyclisation of 2'-hydroxychalcones leading to Z-aurones (the number of compounds studied was three only), this provides an alternative route to AFO oxidation of chalcones or the condensation of coumaranones with aldehydes for synthesizing aurones. However, two later reports on the subject give such erroneous 1H NMR data so as to cast serious doubts on the success of the reactions.

Ready availability of a number of more elaborated 2'-hydroxychalcones prompted us to verify and study the scope of the reaction. These chalcones had been prepared in an earlier investigation and had been converted to the corresponding flavones and α-pyranoflavones. As can be seen from Scheme I, the chalcones used carry acetamido and lactone moieties,

\[
\begin{align*}
1. & \quad R = p\text{-methoxyphenyl} \\
2. & \quad R = 3,4\text{-dimethoxyphenyl} \\
3. & \quad R = 3,4,5\text{-trimethoxyphenyl} \\
4. & \quad R = 3,4\text{-methyleneedioxyphenyl} \\
5. & \quad R = \text{o-chlorophenyl} \\
6. & \quad R = \text{p-chlorophenyl} \\
7. & \quad R = 3,4\text{-methyleneedioxyphenyl} \\
8. & \quad R = \text{o-hydroxyphenyl} \\
9. & \quad R = p\text{-methoxyphenyl} \\
10. & \quad R = 3,4\text{-dimethoxyphenyl} \\
11. & \quad R = 3,4\text{-methyleneedioxyphenyl} \\
12. & \quad R = p\text{-methoxyphenyl} \\
13. & \quad R = 3,4\text{-dimethoxyphenyl}
\end{align*}
\]
beyond the methoxy or chloro substituents. Mercuric acetate oxidation of these thirteen chalcones proceeded smoothly in DMSO at reflux temperatures to yield the corresponding aurones in more than 50% yields. The identity of the products has been established beyond doubt by $^1$H NMR, MS and UV spectroscopy. As expected the benzylidene hydrogen resonance was observed between δ 6.5 and 7.0 (ref. 6). The mass spectrum of the aurones showed the molecular ion peaks and other characteristic peaks expected to arise from the rings A and B of the molecules. Compounds containing chlorine as a substituent showed isotopic peaks, while the compounds carrying coumarin nucleus showed a loss of 28 mass units (M-CO). In compounds with N-acetyl moieties there was a peak which could arise by the loss of 43 mass units. Common fragmentation pattern has been shown in Chart 1. The UV spectrum of 1 was also recorded in ethanol and compared with that of the corresponding flavone. It showed band I absorption at a longer wavelength (λ max 395 nm) than the corresponding flavone (λ max 325 nm) as anticipated. The characterization data of these compounds are given in Table I.

Aurones have been found to be potential candidates against parasitic protist Cryptosporidium parvum$^8$ and Leishmania infections$^9$. Their in vitro activity against Plasmodium falciparum strains K1 and NF 54 has also been reported with encouraging results$^{10}$. In the present work, all the compounds have been tested for antibacterial activity against Staphylococcus aureus and Escherichia coli by cup-plate method$^{11}$.

The highest activity was observed in case of compound 7 to an extent of 75% against S. aureus as compared to norfloxacin.

**Experimental Section**

All the melting points were recorded in liquid paraffin bath using open-end capillaries and are uncorrected. TLC analysis was done on glass plates coated with silica gel G and spotting was done using iodine or UV light. $^1$H NMR spectra were recorded in CDCl$_3$ on a Bruker 300 MHz NMR spectrometer (internal standard TMS). The mass spectra were recorded on a JEOL 5×102/DA-6000 Mass Spectrometer. All the compounds gave satisfactory elemental analysis within ±0.4% of the theoretical values.

**General procedure for the synthesis of aurones**

The chalcone (0.01 mole) was dissolved in DMSO (25 mL) and after adding mercuric acetate (0.015 mole), the contents were refluxed for 6 hr, cooled and poured into ice-cold water. A yellow coloured solid mass separated out which was filtered, washed well with water, dried and crystallised from methanol. The characterization data of the compounds are given in Table I.

**Antibacterial activity**

All the aurones were screened for their antibacterial activity against Staphylococcus aureus and Escherichia coli using norfloxacin as standard drug. Nutrient Agar was used as culture medium. Test solution and standard drug having 100 μg/mL...
The OH and NH protons exchanged by D2O.

<table>
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<tr>
<th>Compd</th>
<th>Yield (%)</th>
<th>m.p. °C</th>
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<tbody>
<tr>
<td>1</td>
<td>50.0</td>
<td>98-100</td>
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Spectral data

**Table I** — Characterization data of the synthesized compounds 1-13.

<table>
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<th>Compd</th>
<th>Antimicrobial activity (% Inhibition)</th>
<th>Spectral data</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>S. aureus</td>
<td>E. coli</td>
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<tr>
<td>1</td>
<td>59.0</td>
<td>50.0</td>
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<tr>
<td>2</td>
<td>63.6</td>
<td>47.9</td>
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<td>3</td>
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<td>56.9</td>
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<tr>
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<td>51.0</td>
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<tr>
<td>7</td>
<td>75.0</td>
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The authors are thankful to (late) Hakim Abdul Hameed Sahib (Founder Chancellor and Builder of Jamia Hamdard) and Mr A Muheed (President, Hamdard National Foundation) for providing the facilities to carry out this research work.

**Acknowledgement**

The results of the antibacterial activity are given in **Table II**.

<table>
<thead>
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<th>Spectral data</th>
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<td>39.0</td>
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References