SYNTHESIS AND GREEN BROMINATION OF SOME CHALCONES AND THEIR ANTIMICROBIAL SCREENING

Mayur R. Adokar*
Department of Chemistry, Sant Gadge Baba Amravati University, Amravati, India

Email: mayuradokar@rediffmail.com

Article Received on: 13/02/13 Revised on: 07/03/13 Approved for publication: 11/04/13

DOI: 10.7897/2230-8407.04438

IRJP is an official publication of Moksha Publishing House. Website: www.mokshaph.com
© All rights reserved.

ABSTRACT
Chalcones are the versatile molecules having the structural flexibility which permits structural transformations into flavonoids, flavanones, pyrazoles, oxazoles, pyrimidines etc. Changes in their structure have offered the development of new medicinal agents having improved pharmacological potency. Their derivatives have attracting attention due to numerous pharmacological potential. In the present communication we report the synthesis of chalcones from various acetophenone derivatives with different aromatic aldehydes and green chemistry approach to their bromination with the help of Tetrabutylammonium Tribromide (TBATB). All the synthesized chalcone dibromides were screened for their antimicrobial activity against Aspergillus flavus, Rhizopus sp., Fusarium solani and Aspergillus niger.

KEYWORDS: Chalcone, brominated chalcones, Tetrabutylammonium Tribromide, antimicrobial activity.

INTRODUCTION
Chalcones are well known intermediate for synthesizing various heterocyclic compounds. Chalcones are characterized by their possession of a C6 (A)-CO-CH=CH-C6 (B) structure, two aromatic ring (A & B) are linked by an aliphatic three-carbon chain which does not participate in forming a hetero ring as is usually found in other types of flavonoids compounds. A few dihydrochalcones C6 (A)-CO-CH2-CH2-C6 (B) have been found though no evidence concerning the relationship between chalcones and dihydrochalcones or the co-existence of these two compounds is yet known. Synthetic methods involve the condensation of o-hydroxyacetophenone with substituted benzaldehyde in the presence of acidic or basic condensing agent to give a chalcone, flavanone or a mixture of these. However the suitable methods involve the condensation by means of alkali. Polymethoxy derivative condenses with 50 percent, 60 percent and 70 percent potassium hydroxide in aqueous alcohol to give the chalcones. Chalcones and flavanones are isomeric and undergo interconversion readily where acids or alkali acts as a catalyst and the change can take place in either direction, usually in acid medium the formation of the flavanone is more favoured in alkaline medium. A considerable variety of methods are available for the preparation of polyhydroxy chalcones. However the methods for the preparation of chalcones show large number of variations. Higher concentration of alkali results self condensation of acetophenone. Whereas the lower concentration of alkali requires longer time for condensation.

Geiger and Con during their chemical studies on the structure of chloroform found that a structural feature which was responsible for antibacterial activity was α, β-unsaturated keto functional group. Green Chemistry is defined as invention, design, development and application of chemical products and processes to reduce or to eliminate the use and generation of substances hazardous to human health and environment. Professional developments involved in reinventing the use of materials. Understanding the challenge and prospective impact of Green Chemistry depends on some familiarity with the context of its adoption and practice. Bromination, especially of aromatic substrates, is usually carried out by elemental bromine, but owing to hazards associated with bromine preferably organic ammonium tribromides (OATB), and pyridine hydrobromide perbromide are used. Because of smoothly with selective bromination of an activated aromatic ring in the presence of an olefinic double bond is possible with such a reagent. Several tribromides have been reported i.e, tetramethyllammonium tribromide (TMATB), phenyltrimethylammonium tribromide (PTATB), tetrabutylammonium tribromide (TBATB). The compounds with the backbone of chalcones have been reported to possess various biological activities such as antimicrobial, antioxidant, anti-inflammatory, Analgesic, antiulcerative, antimalarial, anticancer, antitubercular, antihyperglycemic.

MATERIALS AND METHODS
Melting points reported were determined in a hot paraffin bath and are uncorrected. The IR spectra were recorded on SHIMADZU FTIR Prestige-21 spectrophotometer mode 1310. H NMR spectra were recorded on Varian NMR Mercury-300 spectrometer in CDC13 solvent with TMS as an internal standard.

General procedure for the preparation of chalcones (3a-e)
To a cooled solution of NaOH and ethanol, acetophenone (0.043 mole) was added followed by the addition of substituted aromatic benzaldehyde (0.043 mole), the reaction mixture was stirred for 2-3 hours till the mixture becomes viscous and then the mixture was kept overnight in a refrigerator. The separated product was filtered under suction and washed well with cold water. Then it was crystallized from rectified spirit.

Synthesis of green reagent tetrabutylammonium tribromide (TBATB)
A solution of 2.75 mmol of V2O5 in 44.1 mmol of 30% H2O2 at 5°C on reaction with 11 mmol of TBAB in 7 ml of water at ambient temperature produces yellow Bu4NBr3 (TBATB)
with 70% yield. The yield can be raised to 97% by the use of a catalytic amount of V₂O₅ and dilute H₂SO₄ and two molar equivalent of KBr. The product on crystallization from acetonitrile affords orange–yellow crystals with a sharp melting point of 75 °C

The structure of all the synthesized compounds was confirmed on the basis of elemental analysis, molecular weight determination and spectral analysis and are discussed below.

1. 2,3-dibromo-3-(4-methoxyphenyl)-1-phenylpropan-1-one (4a):
Pale Yellow Solid, M.P. = 80°C, Yield = 94%, Elemental analysis for C₁₆H₁₂O₃Br₂: Found C = 48.23, H = 3.53, Br = 40.11, O = 8.01, Calculated C = 48.27, H = 3.54, Br = 40.14, O = 8.04., IR (cm⁻¹): 3060.17 (Ar-CH), 1672.57 (C=O), 1514.17 (C-C In ring), 689.57 (Ar-H), 685.4 (C-Br); ¹H NMR (οppm): 8.0 (d, 2H, Ar-H), 7.6 (dd, 2H, Ar-H), 7.4 (d, 2H, Ar-H), 6.9 (d, 2H, CH-C-O), 3.8 (s, 3H, O-CH₃).

2. 2,3-dibromo-3-(3-nitrophenyl)-1-phenylpropan-1-one (4b):
Pale Yellow Solid, M.P. = 152°C, Yield = 95%, Elemental analysis for C₁₆H₁₂NO₃Br₂: Found C = 43.59, H = 2.64, Br = 38.66, N = 3.34, O = 11.58, Calculated C = 43.62, H = 2.68, Br = 38.69, N = 3.39, O = 11.62. IR (cm⁻¹): 3076.08 (Ar-CH), 1690.17 (C=O), 1595.25 (C-C In ring), 866.10 (Ar-H), 689.57 (C-Br); ¹H NMR (οppm): 8.10 (s, 1H, CH-C-NO₂), 7.8 (d, 2H, Ar-H), 7.5 (d, 1H, Ar-H), 7.3 (d, 2H, Ar-H).

3. 2,3-dibromo-3-(4-methoxyphenyl)-1-(3-nitrophenyl)propan-1-one (4c):
Brownish Yellow Solid, M.P. = 105°C Yield = 89%, Elemental analysis for C₁₆H₁₃NO₃ Br₂: Found C = 43.32, H = 2.91, Br = 36.03, N = 3.09, O = 14.43, Calculated C = 43.37, H = 2.96, Br = 36.07, N = 3.16, O = 14.44., IR (cm⁻¹): 3150 (Ar-CH), 1689.39 (C=O), 1570.59 (C-C In ring), 1532.0 (N-O), 823.15 (Ar-H), 563.23 (C-Br); ¹H NMR (οppm): 8.9 (s, 1H, CH-C-NO₂), 8.4 (d, 1H, Ar-H), 8.2 (d, 1H, Ar-H), 7.9 (d, 2H, Ar-H), 3.9 (s, 3H, O-CH₃).

4. 2,3-dibromo-3-(3-chlorophenyl)-1-(2,4-dichlorophenyl)propan-1-one (4d):
White Solid, M.P. = 65°C, Yield = 92%, Elemental analysis for C₁₆H₁₂Cl₂Br₂: Found C = 44.72, H = 2.73, Br = 39.67, Cl = 8.78, O = 3.74, Calculated C = 44.59, H = 2.75, Br = 39.70, Cl = 8.81, O = 3.79., IR (cm⁻¹): 3065.47 (Ar-CH), 1690.87 (C=O), 1590.12 (C-C In ring), 765.75 (Ar-H), 580.59 (C-Br); ¹H NMR (οppm): 7.8 (d, 2H, Ar-H), 7.6 (dd, 1H, Ar-H), 7.5 (d, 2H, Ar-H), 7.3 (d, 1H, CH-C-CI).

5. 2,3-dibromo-3-(3-chlorophenyl)-1-phenylpropan-1-one (4e):
Pale Yellow Solid, M.P. = 58°C Yield = 94%, Elemental analysis for C₁₆H₁₂Cl₃Br: Found C = 44.72, H = 2.73, Br = 39.67, Cl = 8.78, O = 3.74, Calculated C = 44.79, H = 2.75, Br = 39.70, Cl = 8.81, O = 3.79., IR (cm⁻¹): 3065.47 (Ar-CH), 1690.87 (C=O), 1590.12 (C-C In ring), 765.75 (Ar-H), 580.59 (C-Br); ¹H NMR (οppm): 7.8 (d, 2H, Ar-H), 7.6 (dd, 1H, Ar-H), 7.5 (d, 2H, Ar-H), 7.3 (d, 1H, CH-C-CI).

Antimicrobial Screening
Antimicrobial screening was done by using cup plate method at a concentration of 100µg/ml. The compounds were evaluated for antimicrobial activity against Rhizopus sp., Aspergillus flavus, Fusarium solani and Aspergillus niger. The results of antimicrobial data are summarized in table 1. All compounds show the moderate to good activity.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Rhizopus sp.</th>
<th>Aspergillus flavus</th>
<th>Fusarium solani</th>
<th>Aspergillus niger</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a</td>
<td>14</td>
<td>16</td>
<td>08</td>
<td>13</td>
</tr>
<tr>
<td>4b</td>
<td>06</td>
<td>11</td>
<td>12</td>
<td>07</td>
</tr>
<tr>
<td>4c</td>
<td>09</td>
<td>12</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>4d</td>
<td>13</td>
<td>17</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>4e</td>
<td>19</td>
<td>16</td>
<td>13</td>
<td>15</td>
</tr>
</tbody>
</table>
RESULTS

The IR spectrum of compounds in KBr shows the characteristic band in the region of 1700 ± 100 cm\(^{-1}\) which indicate the presence of -C=O group. \(^1\)H NMR spectrum of compounds shows doublet of -CO-CH= at 6 6.9 confirmed the presence of chalcone moiety. Result of IR and \(^1\)H NMR analysis confirmed formation of desired products.

The environmentally benign synthesized compounds show the moderate to good antimicrobial activity against *Rhizopus sp.*, *Aspergillus flavus*, *Fusarium solani* and *Aspergillus niger*.

DISCUSSION

QATBs capable of brominating a wide variety of organic substrates including aromatics in a safer way, either promoted by \(\text{V}_2\text{O}_5\)-\(\text{H}_2\text{O}_2\) or catalyzed by \(\text{MoO}_4^{2-}\)-\(\text{H}_2\text{O}_2\). The scope of the protocols has been underscored, and the relevance to green chemistry has been highlighted.

Reactions of peroxometal intermediates can as well be exploited to generate an active brominating species (Br\(^+\)) *in situ* which can also perform bromination of organic substrates very efficiently without compromising with the environmental acceptability.

ACKNOWLEDGEMENT

Author thankful to the Department of Chemistry, Department of Microbiology, SGB Amravati University, Amravati for providing the necessary facilities. Also to the Director, CIC, SGBAU, Amravati for IR spectrum analysis.

REFERENCES


Cite this article as:


Source of support: Nil, Conflict of interest: None Declared