Studies on Cycloimmonium Ylides. Synthesis of Some 2,4,6-Triaryl-Substituted Pyridines via Isoquinolinium Ylides

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(Aroylmethylene)isoquinolinium ylides on their reaction with different α,β-unsaturated ketones gave a wide variety of 2,4,6-triaryl-substituted pyridines which are expected to possess some potential biological activities. The reaction seemed to proceed via (pentane-1,5-dionyl)isoquinolinium derivatives (3a–t) as intermediates. Ammonium acetate in acetic acid was used as a cyclization agent. The structures of the pyridines so synthesized were confirmed by IR and NMR spectral data.

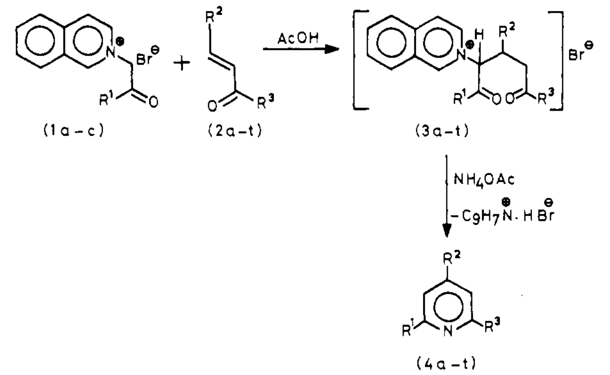
Introduction

The reaction of carbonyl-stabilized pyridinium ylides with a variety of carbonyl compounds for the synthesis of heterocyclic systems has been investigated earlier.[1-5] However, the reaction of carbonyl-stabilized isoquinolinium ylides with carbonyl compounds, particularly the α,β-unsaturated carbonyl system, has been relatively less explored until recently.[6] With a view to examine the synthetic potentialities of carbonyl-stabilized isoquinolinium ylides toward α,β-unsaturated ketones, presently we wish to report the synthesis of some 2,4,6-triaryl-substituted pyridines via phenacylideneisoquinolinium ylides, (4-chlorophenacylidene)isoquinolinium ylides, and (4-phenylphenacylidene)isoquinolinium ylides, generated from their precursors (**1a–c**).

Results and Discussion

Phenacylisoquinolinium bromide (**1a**), (4-chlorophenacyl)isoquinolinium bromide (**1b**), and (4-phenylphenacyl)isoquinolinium bromide (**1c**) were obtained in good yields as a result of quaternization of isoquinoline with respective α-bromo ketones. Structural assignments of the resulting isoquinolinium salts are based on NMR spectral data. NMR spectra of the isoquinolinium salt showed a characteristic peak at δ 7.00 due to the methylene protons attached to the nitrogen of the isoquinoline ring. Aromatic multiplets appeared in the range δ 7.20 to 10.20.

Scheme I



The reaction of isoquinolinium salt (**1a–c**) with various α,β-unsaturated ketones (**2a–t**) in acetic acid using ammonium acetate as cyclization agent yielded 2,4,6-triaryl-substituted pyridines (**4a–t**) (Scheme I).

The reaction presumably proceeds via intermediacy of ylide carbanion, generated from their precursors (**1a–c**), which then undergoes Michael-type addition onto the α,β-unsaturated carbonyl system to yield (pentane-1,5-dionyl)isoquinolinium derivatives (**3a–t**) which, further, on cyclization in the presence of ammonium acetate gave a variety of 2,4,6-triaryl-substituted pyridines.

Various pyridines synthesized are listed in Table I. The structures of the resulting pyridines were supported by microanalyses, which are in good accord with the calculated values, and also by spectral data. The IR spectra (Table II) of the

Table I. Structure and Physical Properties of 2,4,6-Triaryl-Substituted Pyridines (Compounds 4a–t)[g]

compd	molecular formula	R_1	R_2	R_3	mp, °C	% yield	crystallization solvent
4a	$C_{23}H_{17}N$	C_6H_5	C_6H_5	C_6H_5	137–138[a]	63	C_5H_5N-MeOH(aq)
4b	$C_{23}H_{16}BrN$	C_6H_5	C_6H_5	4-BrC_6H_4	152–153[b]	55	$CHCl_3$-MeOH
4c	$C_{24}H_{17}NO_2$	C_6H_5	3,4-$OCH_2OC_6H_3$	C_6H_5	156–158[c]	50	$CHCl_3$-MeOH
4d	$C_{30}H_{21}NO_2$	C_6H_5	3,4-$OCH_2OC_6H_3$	4-biphenyl	155–156	60	$CHCl_3$-MeOH
4e	$C_{24}H_{16}BrNO_2$	C_6H_5	3,4-$OCH_2OC_6H_3$	4-BrC_6H_4	138–140[d]	55	C_5H_5N-MeOH
4f	$C_{26}H_{23}NO_2$	C_6H_5	3,4$(OCH_3)_2C_6H_3$	4-$CH_3C_6H_4$	120–121	60	C_5H_5N-MeOH
4g	$C_{23}H_{15}Cl_2N$	C_6H_5	4-ClC_6H_4	4-ClC_6H_4	138–140	55	C_5H_5N-MeOH
4h	$C_{25}H_{21}NO_2$	C_6H_5	4-$OCH_3C_6H_4$	4-$OCH_3C_6H_4$	102–103[e]	50	C_5H_5N-MeOH
4i	$C_{23}H_{15}Cl_2N$	4-ClC_6H_4	C_6H_5	4-ClC_6H_4	178–179	63	$CHCl_3$-MeOH
4j	$C_{24}H_{18}ClNO$	4-ClC_6H_4	C_6H_5	4-$OCH_3C_6H_4$	104–105	55	C_5H_5N-MeOH
4k	$C_{24}H_{15}Cl_2NO_2$	4-ClC_6H_4	3,4-$OCH_2OC_6H_3$	4-ClC_6H_4	188–189	65	$CHCl_3$-MeOH
4l	$C_{24}H_{18}ClN$	4-ClC_6H_4	4-$CH_3C_6H_4$	C_6H_5	155–156	40	$CHCl_3$-MeOH
4m	$C_{25}H_{20}ClN$	4-ClC_6H_4	4-$CH_3C_6H_4$	4-$CH_3C_6H_4$	183–184	50	$CHCl_3$-MeOH
4n	$C_{24}H_{17}Cl_2N$	4-ClC_6H_4	4-$OCH_3C_6H_4$	4-ClC_6H_5	180–181	40	$CHCl_3$-MeOH
4o	$C_{25}H_{20}Cl\cdot NO_2$	4-ClC_6H_4	3,4-$(OCH_3)_2C_6H_4$	C_6H_5	100–101	55	C_5H_5N-MeOH
4p	$C_{26}H_{22}Cl\cdot NO_2$	4-ClC_6H_4	3,4-$(OCH_3)_2C_6H_4$	4-$CH_3C_6H_4$	140–141	50	C_5H_5N-MeOH
4q	$C_{35}H_{25}N$	4-biphenyl	C_6H_5	4-biphenyl	192–193[f]	60	C_5H_5N-MeOH
4r	$C_{30}H_{23}N$	4-biphenyl	C_6H_5	4-$CH_3C_6H_4$	172–173	50	$CHCl_3$-MeOH
4s	$C_{31}H_{25}N$	4-biphenyl	4-$CH_3C_6H_4$	4-$CH_3C_6H_4$	176–177	50	$CHCl_3$-MeOH
4t	$C_{32}H_{27}NO_2$	4-biphenyl	3,4-$(OCH_3)_2C_6H_3$	4-$CH_3C_6H_4$	78–79	60	C_5H_5N-MeOH

[a] Lit.[1] 138 °C. [b] Lit.[4] 150–152 °C. [c] Lit.[4] 152–153 °C. [d] Lit.[4] 136–138 °C. [e] Lit.[4] 101–104 °C. [f] Lit.[5] 194–196 °C. [g] Satisfactory elemental analyses were obtained for all compounds.

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Table II. NMR and IR Spectra for 2,4,6-Triaryl-Substituted Pyridine

	NMR data ($CDCl_3$),[a] δ		IR data (KBr), cm^{-1}		
compd	aliphatic H	aromatic H	CH strech vibrations	C=C vibrations	C=N vibrations
4a			3150	1595	1465
4b					
4c	5.90 s, $-OCH_2O$	7.12-8.24 m			
4d	6.04 s, $-OCH_2O$	6.85-8.20 m			
4e	5.97 s, $-OCH_2O$	6.80-8.10 m	3003	1600	1546
4f	2.35 s, $-CH_3$ 3.85-3.90 d, $-OCH_3$ ($J = 4$ Hz)	6.93-8.13 m			
4g			3157	1610	1475
4h	3.90 s, $-OCH_3$	7.50-8.41 m	3007	1608	1546
4i			3115	1605	1500
4j	3.83 s, $-OCH_3$	6.90-8.30 m			
4k	6.00 s, $-OCH_2O$	6.96-8.10 m			
4l	2.39 s, $-CH_3$	6.78-7.73 m			
4m	2.40 s, $-CH_3$	7.20-8.16 m			
4n	3.76 s, $-OCH_3$	6.80-8.00 m			
4o	3.70-3.75 d, $-OCH_3$ ($J = 5$ Hz)	6.70-7.80 m			
4p	2.40 s, $-CH_3$ 3.85-3.90 d, $-OCH_3$ ($J = 5$ Hz)	7.03-8.20 m			
4q			3000	1590	1570
4r	2.40 s, $-CH_3$	7.16-8.30 m			
4s	2.41 s, $-CH_3$	7.20-8.30 m			
4t	2.47 s, $-CH_3$ 3.85-3.90 d, $-OCH_3$ ($J = 4$ Hz)	7.00-8.40 m			

[a] Key: s = singlet, d = doublet, m = multiplet.

pyridines in general showed a characteristic absorption band in the region 3077-3000 cm^{-1} which is assigned to the C-H stretching mode of pyridine rings. The bands in the region between 1600 and 1500 cm^{-1} are assigned to the interaction between C=C and C=N vibrations of the pyridine rings.[7] The former band, appearing as a double absorption maxima near 1600 cm^{-1} appears to be a general characteristic of trisubstitution at the pyridine nucleus.[8] The chemical shift in the NMR spectra of 2,4,6-triaryl-substituted pyridines exhibits two pyridyl protons (singlet) in the range δ 7.00 to 7.45 and an aromatic multiplet in the range δ 7.50 to 8.45.

Experimental Section

Melting points were determined on a Gallenkamp apparatus and are uncorrected. The IR spectra were recorded on a Perkin-Elmer infracord spectrophotometer using KBr. The NMR spectra ($CDCl_3$) were run on a Varian A-60 spectrometer with tetramethylsilane as internal standard. Analytical samples were purified by column chromatography over neutral alumina, and purity was checked by thin-layer chromatography (TLC).

Isoquinolinium salts were prepared by treatment of α-bromo ketones with isoquinoline in dry benzene at reflux temperature.

Preparation of 2,4,6-Triaryl-Substituted Pyridines

To a stirred solution of 3 mmol of isoquinolinium salts (**1a-c**) in 10 mL of glacial acetic acid was added gradually a solution of α,β-unsaturated ketones (**2a-t**, 3 mmol) in 30 mL of glacial acetic acid in the presence of ammonium acetate under an inert atmosphere of nitrogen at reflux temperature for 3 h. The reaction mixture was then kept overnight at room temperature. It was then washed with ice cold water and the precipitated product so obtained was washed twice with methanol and was crystallized by the appropriate solvent mentioned in Table I.

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Literature Cited

(1) Krohnke, F.; Zecher, W. *Chem. Ber.* **1961**, *94*, 690.
(2) Kendurkar, P. S.; Tewari, R. S. *J. Chem. Eng. Data* **1974**, *19*, 184.
(3) Kendurkar, P. S.; Tewari, R. S. *Z. Naturforsch., B* **1974**, *29*, 184.
(4) Tewari, R. S.; Gupta, K. C. *Indian J. Chem., Sect. B* **1976**, *14*, 829.
(5) Tewari, R. S.; Nagpal, D. K.; Chaturvedi, S. C. *Indian J. Chem.*, in press.
(6) Zugravescu, I.; Petrovanu, M. "N-Ylide Chemistry"; Editura Academici Republicii Socialistc: Romania, 1976, p 210.
(7) Bellamy, L. J. "The Infrared Spectra of Complex Molecules"; Wiley: New York, 1954; pp 271-81.
(8) Cook, G. L., Church, F. M. *J. Phys. Chem.* **1957**, *61*, 458.

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Spectral and Thermal Data on Poly(styrene peroxide)

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Poly(styrene peroxide) has been prepared and characterized. Nuclear magnetic resonance (NMR) spectra of the polymer show the shift of aliphatic protons. Differential scanning calorimetric (DSC) and differential thermal analysis (DTA) results show an exothermic peak around 110 °C which is characteristic of peroxide decomposition.

Introduction

Polymeric peroxides are generally formed by the reaction of monomer with O_2.[1] Many of the polymeric peroxides are explosive materials. These polymeric peroxides have been used as initiators in polymerization reactions. They have also the potential for use in propellants[2,3] and explosives. The synthesis of poly(styrene peroxide) (PSP) has been reported earlier[5-7] and has been characterized by infrared (IR) spectra iodometric

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