A New Route to 2,4,6-Triarylpyridines via Stabilized Sulfuranes

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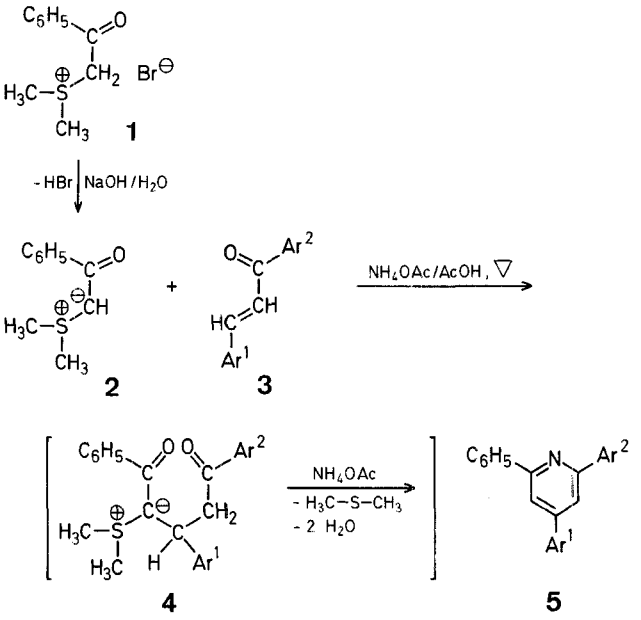
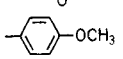
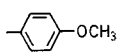
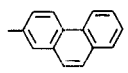
Pyridinium phenacylides are known to react with chalcone-type 1-alkenyl ketones in the presence of ammonium acetate to give 2,4,6-triarylpyridines via cyclization of an intermediate 2-pyridinio-1,5-diketone which is, in turn, formed by attack of the ylid carbanion on C-β of the α,β-unsaturated ketone, the reaction being facilitated by the fact that the pyridinium cation is a good leaving group[1,2]. In view of the ability of sulfonium groups to act as good leaving groups we investigated a similar synthesis of 2,4,6-triarylpyridines using sulfuranes (sulfonium ylids) in place of pyridinium ylids. Sulfonium ylids have hitherto been used in a variety of syntheses, e.g., of epoxides[3], aziridines[4], and cyclopropanes[5].

Our synthesis of 2,4,6-triarylpyridines (**5**) consists of the reaction of phenacylidenedimethylsulfurane (**2**) with an equimolar amount of a chalcone (**3**) and ammonium acetate in acetic acid. The reaction presumably proceeds via the intermediacy of a 2-sulfonio-1,5-diketone[6,7] (**4**) which undergoes cyclocondensation with ammonium acetate to give **5**.



The 2,4,6-triarylpyridines **5** may also be directly prepared by condensation of phenacyldimethylsulfonium bromide (**1**) with chalcones **3** without isolation of the intermediate sulfuranes **2**, the yields of **5** being 40–62%.

Table. Pyridines **5** prepared

5	Ar^1	Ar^2	Yield [%]	m.p.[a] [°C] found	m.p.[a] [°C] reported or Molecular formula[b]	I.R.[c] (KBr) ν [cm^{-1}]	^{1}H-N.M.R.[d] ($CDCl_3$/TMS) δ [ppm]
a			70	130–131°	135°[10]	3020 (CH stretching); 1600 (C=C); 1555 (C=N); 1030[e]	
b			76	160–161°	$C_{21}H_{16}ClN$ (317.7)	3070 (CH stretching); 1600 (C=C); 1495 (C=N); 1020[e]	
c			50	147–148°	152°[11]		6.08 (s, 2H, O–CH_2–O); 7.08 (s, $2H_{pyridyl}$); 7.3–8.0 (m, $13H_{arom}$)
d			70	165–166°	$C_{24}H_{18}ClNO$ (371.7)		3.90 (s, 3H, O–CH_3); 7.15 (s, $2H_{pyridyl}$); 7.2–8.02 (m, $13H_{arom}$)
e			80	280–281°	$C_{32}H_{23}NO$ (437.2)		3.90 (s, 3H, O–CH_3); 7.20 (s, $2H_{pyridyl}$); 7.2–8.5 (m, $18H_{arom}$)
f		H	62	80–81°	$C_{17}H_{13}N$ (231.0)	—	—

[a] Melting points were determined using a Gallenkamp apparatus and are uncorrected.
[b] The microanalyses were in good accord with the calculated values: C, ±0.07; H, ±0.07.
[c] Recorded on a Perkin Elmer Infracord instrument.
[d] Recorded on Varian A-60 spectrometer.
[e] C–H out-of-plane deformations of the pyridine ring.

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Our method using sulfuranes **(2)** or the precursor sulfonium salts **(1)** is carried out under mild conditions and gives better yields of 2,4,6-triarylpyridines than are obtained by the pyridinium salt method or other methods[1,2]. With modifications as regards starting materials it can also be applied to the synthesis of pyridines **5** having alkyl groups or even H-atoms in place of aryl groups.

The nature of the solvent used has a pronounced influence on the reaction rate. In dimethylformamide, the reaction proceeds much slower than in acetic acid and in dimethyl sulfoxide no reaction is observed.

The structure of compounds **5** was established by microanalyses, physical and spectral data. An alternative structure with Ar^1 and Ar^2 interchanged can be excluded because only the β-CH group of compounds **3** will react with the negative site of the ylid **2**.

Phenacylidenedimethylsulfurane (2):

Phenacyldimethylsulfonium bromide[8] (**1**; 15.0 g, 0.057 mol) is dissolved in water (30.0 ml). The coloured suspension thus obtained is stirred with aqueous 10% sodium hydroxide solution (150 ml) for 50 min and then extracted with chloroform (5 × 20 ml). The extract is dried with anhydrous sodium sulfate and evaporated to give an orange oil which upon cooling solidifies. The product is recrystallized from benzene/petroleum ether to afford **2** as orange crystals; yield: 10.0 g (90%); m.p. 55–56 °C (Ref.[9], m.p. 56–57 °C).

2,4,6-Triarylpyridines (5); General Procedures:

Method A; using Sulfurane **2**: Phenacylidenedimethylsulfurane (**2**; 0.54 g, 3 mmol) is suspended in glacial acetic acid (10 ml) and a solution of the α,β-unsaturated ketone **3** (3 mmol) is added with stirring. Then, ammonium acetate (3.0 g) is added, the mixture is heated at reflux temperature for 4–6 h, and allowed to stand at room temperature overnight. It is finally poured into ice-cold water (20 ml). The precipitated solid product is isolated by suction, washed with water and methanol, dried, and recrystallized from a suitable solvent (usually pyridine/methanol 1/2).

Method B, using Sulfonium Salt **1**: Phenacylidenedimethylsulfonium bromide (**1**; 0.78 g, 3 mmol), α,β-unsaturated ketone **3** (3 mmol) and ammonium acetate (3.0 g) in acetic acid (10 ml) are heated together at reflux temperature for 4–6 h and allowed to stand at room temperature overnight. The mixture is finally poured into ice-cold water (20 ml). The precipitated solid product is isolated by suction, washed with water and methanol, dried and recrystallized form a suitable solvent (usually pyridine/methanol 1/2).

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[1] I. Zugravescu, M. Petrovanu, *N-Ylide Chemistry*, Editura Academici Republicii Socialiste, Romania, 1976, p. 71.
[2] P. S. Kendurkar, R. S. Tewari, *Z. Naturforsch.* [b] **29**, 552 (1974).
[3] B. M. Trost, L. S. Melvin, *Sulfur Ylides*, Academic Press, New York, 1975, p. 51.
[4] R. S. Tewari, A. K. Awasthi, *Indian J. Chem.*, in press (1980).
[5] R. S. Tewari, A. K. Awasthi, *Indian J. Chem.*, in press (1980).
[6] F. Kröhnke, *Angew. Chem.* **75**, 181 (1963); *Angew. Chem. Int. Ed. Engl.* **2**, 225 (1963).
[7] F. Kröhnke, W. Zecher, *Angew. Chem.* **74**, 811 (1962); *Angew. Chem. Int. Ed. Engl.* **1**, 626 (1962).
[8] A. W. Johnson, R. T. Amel, *J. Org. Chem.* **34**, 1240 (1969).
[9] K. W. Ratts, A. N. Yao, *J. Org. Chem.* **31**, 1185 (1966).
[10] W. Zecher, F. Kröhnke, *Chem. Ber.* **94**, 690 (1961).
[11] P. S. Kendurkar, R. S. Tewari, *Z. Naturforsch.* [b] **29**, 552 (1974).