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The aza-Wittig reaction of benzophenone- or acetophenone 1-[(triphenylphosphoranylidene)amino]ethylidenehydrazone (**4**) with aromatic aldehydes provides a new route to 1,2,4-triazoles **7** via the thermal reaction of the expected azinoimines **5**.

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In recent years, there has been a significant interest in the chemistry of iminophosphoranes because of their utility in the synthesis of a wide variety of nitrogen heterocycles, and many interesting heterocyclization reactions involving functionalized iminophosphoranes have been reviewed [1]. Also, we recently described a new route to 1,2,4-triazole-fused heterocycles such as 5,10-dihydro-1,2,4-triazolo[5,1-*b*]quinazolines [2], 4*H*-1,2,4-triazolo[1,5-*c*][1,3,5]-oxadiazines [3], 7*H*-imidazo[1,2-*b*][1,2,4]triazoles [4], and 5,10-dihydro-1,2,4-triazolo[1,5-*b*]isoquinolines [5] involving thermal rearrangement of azinocarbodiimides, *N*-aziridinyliminocarbodiimides or azinoketenimines obtained from the corresponding ureas or carboxamides using Appel's dehydration method [6].

In addition, Schweizer and co-workers reported that the reactions of azine ylides **1** with aldehydes, isocyanates, ketenes, and other species that contain carbonyl or thiocarbonyl moieties have provided excellent syntheses of a variety of pyrazoles or pyrazolo-fused heterocyclic compounds via α,β -unsaturated azines or cumulated azines **2** [7]. However, aza-Wittig reaction of benzophenone 1-[(triphenylphosphoranylidene)amino]ethylidenehydrazone (**4a**) with phenyl isocyanate gave a poor yield (19%) of the 5,10-diphenyl-5,10-dihydro-1,2,4-triazolo[5,1-*b*]quinazoline via carbodiimide intermediate [2]. Reaction of azinoiminophosphorane **4a** with phenylketene, generated *in situ* from phenylacetyl chloride and triethylamine, led to an

extremely complex reaction mixture [5] (Scheme I). We now wish to report that aza-Wittig reactions of azinoiminophosphoranes **4** with aromatic aldehydes give trisubstituted 1,2,4-triazoles by thermal rearrangement of intermediate azinoimines at high temperature.

The key iminophosphoranes **4** were easily prepared by the reaction of a mixture of triphenylphosphine and iodine [8] with known benzophenone 1-aminoethylidenehydrazone (**3a**) [2] or acetophenone 1-aminoethylidenehydrazone (**3b**) [3b]. The aza-Wittig reactions of **4** with two equimolecular amount of aldehydes in xylene at reflux temperature led directly to 43-82 % yields of the 1,3,5-trisubstituted-1,2,4-triazoles **7** [9] (Table 1). A reasonable mechanism for the transformation of **4** into **7** is shown in Scheme II. The presumed intermediate azinoimines **5** were too unstable to isolate, so the thermal reactions of **5** would give the resonance-stabilized azomethine imines **6a-d** followed by 1,3-H shift or proton abstraction, and heteroaromatization to give the 1,2,4-triazoles **7**.

Structural elucidation of **7** was accomplished on the basis of spectral data and microanalyses. The ¹H nmr spectra showed a characteristic peak at $\delta = 2.41$ -2.50 for the

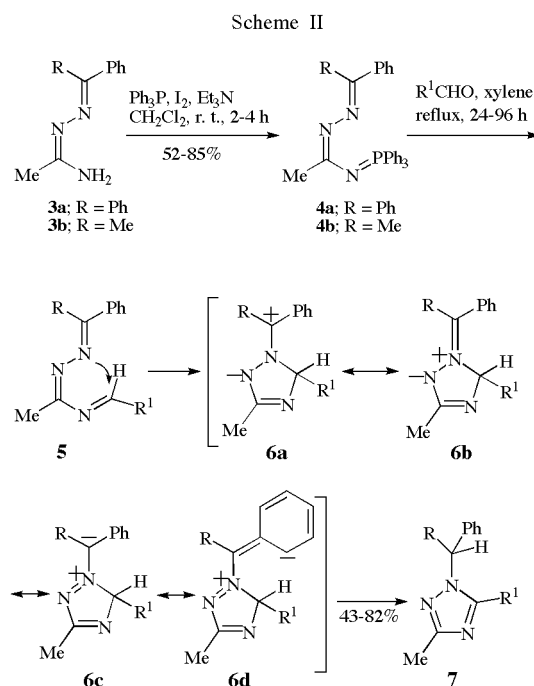
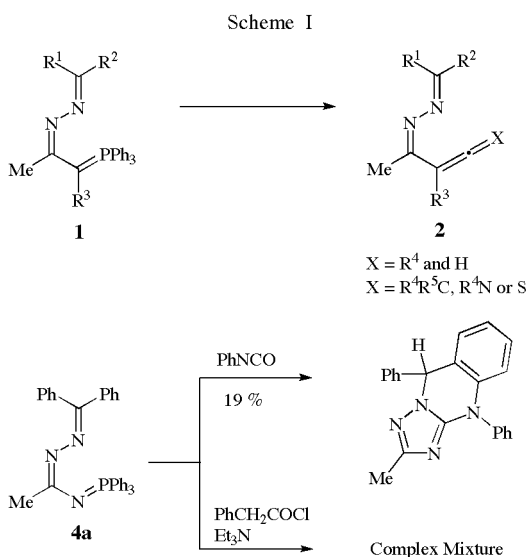


Table 1
1,2,4-Triazoles **7** Prepared

	R	R ¹	Reaction Time (h)	Yield (%)	MP (°C)	Molecular Formula	Analysis (%)		
							Calcd./Found	C	H
7a	C ₆ H ₅	C ₆ H ₅	48	82	146-148	C ₂₂ H ₁₉ N ₃ (325.41)	81.20 81.02	5.88 5.75	12.91 12.73
7b	C ₆ H ₅	<i>p</i> -ClC ₆ H ₄	24	67	162-164	C ₂₂ H ₁₈ ClN ₃ (359.86)	73.43 73.21	5.04 4.83	11.68 11.41
7c	C ₆ H ₅	<i>p</i> -NO ₂ C ₆ H ₄	24	43	187-189	C ₂₂ H ₁₈ N ₄ O ₂ (370.41)	71.34 71.12	4.90 4.80	15.13 14.85
7d	C ₆ H ₅	<i>p</i> -CH ₃ C ₆ H ₄	96	59	169-171	C ₂₃ H ₂₁ N ₃ (339.44)	81.38 81.15	6.24 6.01	12.38 12.17
7e	C ₆ H ₅	<i>p</i> -CH ₃ OC ₆ H ₄	48	43	168-170	C ₂₃ H ₂₁ N ₃ O (355.44)	77.72 77.50	5.96 5.72	11.82 11.98
7f	CH ₃	C ₆ H ₅	48	77	oil	C ₁₇ H ₁₇ N ₃ (263.34)	77.54 77.36	6.50 6.41	15.96 16.23
7g	CH ₃	<i>p</i> -ClC ₆ H ₄	24	70	85-87	C ₁₇ H ₁₆ ClN ₃ (297.79)	68.57 68.72	5.42 5.65	14.11 14.39
7h	CH ₃	<i>p</i> -NO ₂ C ₆ H ₄	24	44	110-112	C ₁₇ H ₁₆ N ₄ O ₂ (308.34)	66.22 65.90	5.23 5.02	18.17 17.88
7i	CH ₃	<i>p</i> -CH ₃ C ₆ H ₄	96	53	56-58	C ₁₈ H ₁₉ N ₃ (277.37)	77.95 77.81	6.90 6.82	15.15 15.34
7j	CH ₃	<i>p</i> -CH ₃ OC ₆ H ₄	48	47	oil	C ₁₈ H ₁₉ N ₃ O (293.37)	73.70 73.47	6.53 6.29	14.32 14.60

Table 2

NMR and Mass Spectra Data of Compounds **7**

	¹ H nmr δ (ppm) (Deuteriochloroform)	Selected ¹³ C nmr δ (ppm) (Deuteriochloroform)	Mass spectra m/z (%)
7a	2.43 (s, 3H), 6.67 (s, 1H), 7.20-7.57 (m, 15H)	14.3, 65.4, 156.0, 160.4	325 (M ⁺ , 11), 167 (100), 165 (20), 152 (10)
7b	2.42 (s, 3H), 6.60 (s, 1H), 7.18-7.47 (m, 14H)	14.2, 65.6, 154.8, 160.5	361 (M ⁺ , 2), 359 (M ⁺ , 5), 167 (100), 165 (18), 152 (9)
7c	2.45 (s, 3H), 6.61 (s, 1H), 7.18-7.37 (m, 10H), 7.74 (d, 2H, J = 8.8 Hz), 8.33 (d, 2H, J = 8.8 Hz)	14.2, 66.1, 153.7, 160.9	370 (M ⁺ , 1), 167 (100), 165 (25), 152 (13)
7d	2.41 (s, 3H), 2.42 (s, 3H), 6.67 (s, 1H), 7.19-7.45 (m, 14H)	14.2, 21.4, 65.3, 156.1, 160.3	339 (M ⁺ , 16), 167 (100), 165 (20), 152 (10)
7e	2.42 (s, 3H), 3.86 (s, 3H), 6.66 (s, 1H), 6.97 (d, 2H, J = 8.7 Hz), 7.20-7.35 (m, 10H), 7.48 (d, 2H, J = 8.7 Hz)	14.2, 55.3, 65.3, 155.9, 160.9	355 (M ⁺ , 27), 167 (100), 165 (17), 152 (10)
7f	1.86 (d, 3H, J = 7.0 Hz), 2.48 (s, 3H), 5.55 (q, 1H, J = 7.0 Hz), 7.25-7.50 (m, 10H)	14.1, 22.3, 57.5, 154.9, 159.9	263 (M ⁺ , 53), 159 (100), 118 (19), 105 (38)
7g	1.87 (d, 3H, J = 7.0 Hz), 2.48 (s, 3H), 5.48 (q, 1H, J = 7.0 Hz), 7.23-7.42 (m, 9H)	14.1, 22.5, 57.9, 153.9, 160.1	299 (M ⁺ , 26), 297 (M ⁺ , 62), 195 (30), 193 (100), 105 (58)
7h	1.90 (d, 3H, J = 7.0 Hz), 2.50 (s, 3H), 5.50 (q, 1H, J = 7.0 Hz), 7.23-7.39 (m, 5H), 7.67 (d, 2H, J = 8.5 Hz), 8.29 (d, 2H, J = 8.5 Hz)	14.1, 22.8, 58.5, 152.8, 160.5	308 (M ⁺ , 39), 293 (17), 105 (100)
7i	1.85 (d, 3H, J = 7.0 Hz), 2.40 (s, 3H), 2.47 (s, 3H), 5.54 (q, 1H, J = 7.0 Hz), 7.23-7.45 (m, 9H)	14.1, 21.3, 22.3, 57.5, 155.1, 159.8	277 (M ⁺ , 60), 173 (100), 105 (26)
7j	1.86 (d, 3H, J = 7.0 Hz), 2.47 (s, 3H), 3.84 (s, 3H), 5.54 (q, 1H, J = 7.0 Hz), 6.95 (d, 2H, J = 8.5 Hz), 7.25-7.55 (m, 7H)	14.1, 22.3, 55.2, 57.4, 154.9, 160.7	293 (M ⁺ , 82), 189 (100), 148 (12), 105 (12)

C3-methyl protons, and methine proton resonated in δ = 6.60 to 6.67 region as singlet for **7a-e** and δ = 5.48 to 5.55 region as quartet for **7f-j**. The characteristic signals found in the ¹³C nmr spectra appear as follows: δ = 14.1-14.3 (C3-CH₃), 159.8-160.9 (C3), 152.8-156.1 (C5), and

methine carbon ranged from δ = 65.3 to 66.1 for **7a-e** and δ = 57.4 to 58.5 for **7f-j**.

We have thus worked out a simple method for the synthesis of 1,3,5-trisubstituted-1,2,4-triazoles from azinoinophosphoranes with aromatic aldehydes.

EXPERIMENTAL

All reagents and solvents were reagent grade or were purified by standard methods before use and the reactions were routinely carried out under an inert atmosphere. Silica gel 60 (70-230 mesh ASTM) used for column chromatography was supplied by E. Merck. Analytical thin layer chromatography (tlc) was performed on silica gel with fluorescent indicator coated on aluminium sheets. Melting points were taken using an Electrothermal melting point apparatus and are uncorrected. Microanalyses were obtained using a Carlo Erba EA 1180 element analyzer. Mass spectra were obtained using a ThermoQuest Polaris Q mass spectrometer operating at 70 eV. The ^1H , ^{13}C and ^{31}P nmr spectra were measured on a Gemini 300 spectrometer. All chemical shifts are reported in parts per million (δ) relative to tetramethylsilane.

The benzophenone 1-aminoethylidenehydrazone (**3a**) [2], acetophenone 1-aminoethylidenehydrazone (**3b**) [3b] and benzophenone 1-[(triphenylphosphoranylidene)amino]ethylidenehydrazone (**4a**) [2] were prepared following literature procedures.

Acetophenone 1-[(Triphenylphosphoranylidene)amino]ethylidenehydrazone (**4b**).

To a solution of triphenylphosphine (866 mg, 3.3 mmoles) in 30 ml of dichloromethane was added iodine (761 mg, 3.0 mmoles) at room temperature. The resulting reaction mixture was stirred at room temperature for 30 minutes and then treated with triethylamine (0.92 ml, 6.6 mmoles) followed immediately by the addition of acetophenone 1-aminoethylidenehydrazone (**3b**, 525 mg, 3.0 mmoles). After stirring for 4 hours at room temperature, the reaction mixture was poured into 20 ml of water and extracted with dichloromethane (20 ml x 2). The combined extracts were dried over magnesium sulfate, concentrated to dryness, and crystallized from petroleum ether to give 679 mg (52%) of **4b**, mp 143-144 $^\circ$; ^1H nmr (deuteriochloroform): δ 1.68 (s, 3H, CH_3), 2.45 (d, 3H, $J = 2.4$ Hz, CH_3), 7.25-7.82 (m, 20H, aromatic); ^{31}P nmr (deuteriochloroform/triphenyl phosphate): δ 33.38.

Anal. Calcd. for $\text{C}_{28}\text{H}_{26}\text{N}_3\text{P}$: C, 77.22; H, 6.02; N, 9.65. Found: C, 77.38; H, 6.10; N, 9.41.

5-Aryl-1-benzhydryl-3-methyl-1*H*-1,2,4-triazoles **7a-e** and 5-Aryl-3-methyl-1-(phenylethyl)-1*H*-1,2,4-triazoles **7f-j**.

General Procedure.

To a solution of iminophosphorane **4** (1.5 mmoles) in 15 ml of xylene were added aldehydes (3.0 mmoles) and this solution was stirred at reflux temperature for the time indicated in Table 1. After cooling to room temperature the solvent was removed on a roto-evaporator. The residue was chromatographed on silica gel column eluting with hexane-ethyl acetate 3:1 to give product **7**. Purification was achieved by crystallization from petroleum ether.

The physical and spectral data of **7** prepared by this general method are listed in Table 1 and Table 2.

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