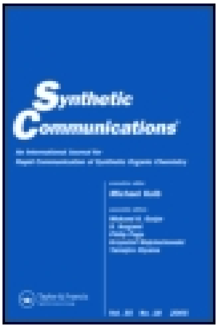

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PHOSPHONIUM YLIDES IN ORGANIC SYNTHESIS III.[1,2] A NOVEL SYNTHESIS OF α-SUBSTITUTED YLIDES AND PYRAZOLE SYSTEMS

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ABSTRACT. A novel synthesis of α-substituted phosphonium ylides and pyrazole systems *via* the treatment of hydrazonoyl halides **1** with phosphoranes **2** and **6**, respectively is reported.

Much greater attention is being given nowadays to organophosphorous compounds.[1,2] Many of these phosphorous compounds have found uses which are comparable, and in many cases, superior to their carbon analogs. Numerous reports in the literature concerning their applications attested to their growing importance as insecticides, herbicides, germicides and above all as drugs.[3-10] Although hydrazonoyl halides have been extensively utilized in organic synthesis,[11-16] little have been reported on the utility of

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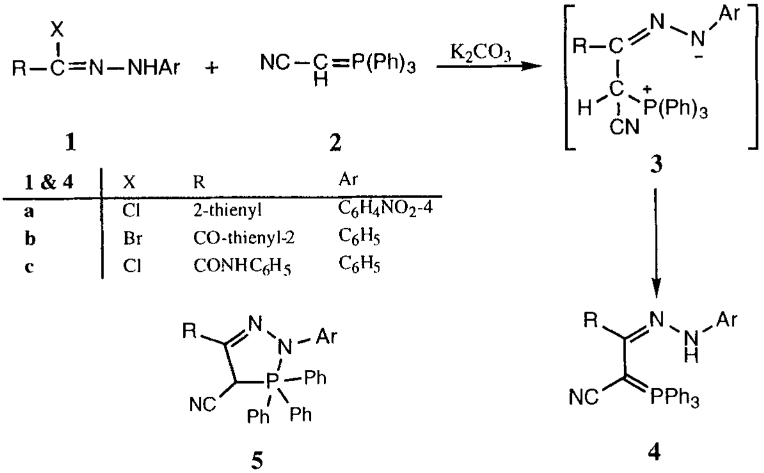
these versatile reagents for building up phosphoranes. Now, we report on the reaction of hydrazonoyl halides **1a-e** with phosphonium ylides **2** and **6** in a novel synthesis of α-substituted ylides **4a-c** and unique pyrazole systems **10a-f**, respectively.

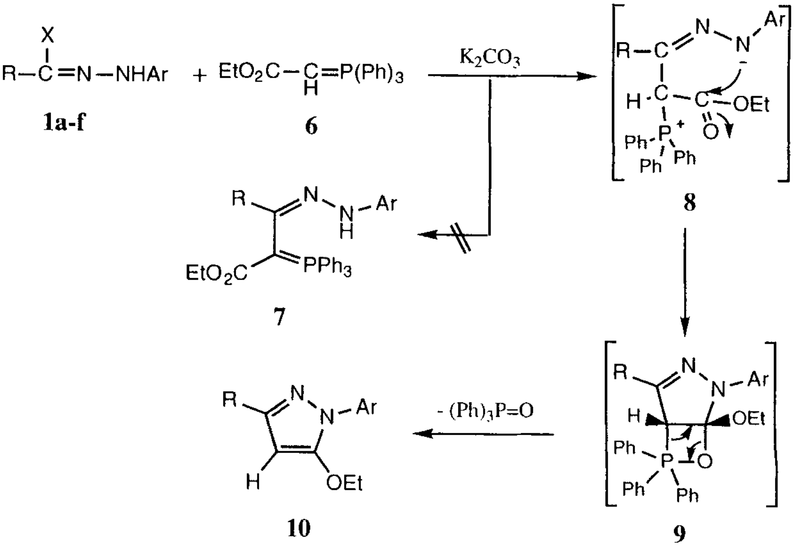
Treatment of hydrazonoyl halides **1a** with cyanomethylenetriphenylphosphorane **2** in benzene containing potassium carbonate resulted in the formation of an addition product having the molecular formula $C_{31}H_{23}N_4O_2PS$. This may be formulated as the ylidic structure **4a** or its cyclic form **5a**. The hydrazone structure **4a** was preferred for the reaction product based on its spectral data. ^1H NMR revealed in addition to the aromatic signals, a singlet signal at $\delta = 4.49$ ppm for NH. This signal disappeared upon the addition of D_2O to the NMR sample which exclude the cyclic form **5a**. Furthermore, the cyclic phosphorane **5a** would be expected to show the methine proton coupled with phosphorus atom with $J_{HP} \approx 11\text{-}13$ Hz.[17] ^{13}C NMR is in support with **4a** which shows no sp^3 carbon atoms besides the aromatic carbon atoms. In addition the ^{13}C NMR chemical shift at $\delta = 175.45$ would be assigned for the C=N group of the hydrazone group. Moreover, the ylidic structure **4a** would also explain the highly red colored nature of the product which are far more stable than the phosphoranes **5**. Similarly, compounds **4b,c** were obtained.

Next, it was of interest to extend our synthetic utility of ylides by using carbethoxymethylenetriphenylphosphorane **6**. Attempts to prepare the α-substituted ylide **7** by reaction of **1** with carbethoxymethylenetriphenylphosphorane **6** were failed. Instead, the reaction of **1a-f** with **6** afforded only 5-ethoxypyrazole derivatives **10a-f**.



1 & 4	X	R	Ar
a	Cl	2-thienyl	$C_6H_4NO_2$-4
b	Br	CO-thienyl-2	C_6H_5
c	Cl	CONHC_6H_5	C_6H_5

Scheme 1



1 & 10	X	R	Ar
a	Cl	2-thienyl	$C_6H_4NO_2$-4
b	Cl	CO_2Et	$C_6H_4NO_2$-4
c	Cl	CONH-C_6H_5	C_6H_5
d	Cl	C_6H_5	C_6H_5
e	Br	COC_6H_5	C_6H_5
f	Cl	$COCH_3$	$C_6H_4NO_2$-4

Scheme 2

The reaction apparently involves the formation of dipolar intermediate **8** which cyclizes *via* the attack of nitrogen nucleophile to the carboethoxy group to yield the cyclic intermediate **9** which aromatized *via* loss of triphenylphosphine oxide to give the final isolable pyrazole derivatives **10a-f** (Scheme 2). The structure of **10a-f** was established *via* its elemental and spectral data.

Experimental

All melting points are uncorrected. The IR spectra were obtained (KBr disc) on a Pye Unicam sp 1100 spectrophotometer, ^{1}H NMR spectra were measured on a Varian EM-390 MHz spectrometer for solutions in $(CD_3)_2SO$ and $CDCl_3$ using *TMS* as internal standard. Mass spectra were recorded with MS 30 (AEI) spectrometer at 70 ev. Analytical data were obtained from Microanalytical Center at Cairo University, Giza, Egypt.

α-Substituted cyanomethylenetriphenylphosphorane 4a-c. *General procedure.* A solution of **1a-c** (0.01 mol) in dry benzene (30 ml) was treated with cyanomethylenetriphenylphosphorane **2** (3 g; 0.01 mol) and anhydrous potassium carbonate (2.7 g; 0.02 mol). The reaction mixture was stirred for two days at room temperature and then evaporated *in vacuo*. The remaining oil was triturated with hot petroleum ether (40-60°C). The remaining residue was purified by using column chromatography (50cm of silica gel (60-120mesh) and the solvent mixture of 20% ethyl acetate and 80% cyclohexane as an eluent, the solid product obtained was crystallized from the appropriate solvent. **4a**: mp 230°C; deep red *crystals* (from benzene), 60% yield; ν_{max}/cm^{-1} (KBr) 3426 (NH), 2215 (CN),1660 (C=O); δ_H [$(CD_3)_2SO$] 4.49 (s, 1H, NH) exchangeable with D_2O, 6.20 (d, 1H, thiophene proton), 6.49 (t, 1H, thiophene proton), 7.25 (d, 1H, thiophene proton), 7.55-7.90 (m, 15H, aromatic protons), 8.20 (d, 2H, aromatic protons), 8.65 (d, 2H, aromatic protons); ^{13}C NMR: 117.19 (CN), 121.83-127.19 (thiophene carbon atoms), 128.45-140.24 (phenyl carbon atoms), 146.48 (C-5), 175.45 (C-3); *m/z* 546; (Found: C, 67.9; H, 4.2; N, 10.1; P, 5.5. $C_{31}H_{23}N_4O_2PS$ requires C, 68.13; H, 4.21; N, 10.25; P, 5.67%). **4b**: mp 182°C, orange *crystals* (from benzene), 65% yield; ν_{max}/cm^{-1} (KBr) 3420 (NH), 2215 (CN), 1695 (C=O); δ_H [$(CD_3)_2SO$] 4.00 (s, 1H, NH), 6.91-7.05 (m, 2H, thienyl protons), 7.10-7.32 (m, 6H, aromatic protons), 7.50-7.95 (m, 15H, aromatic protons); *m/z* 529 (Found: C, 72.7; H, 4.6; N, 8.1; P, 6.0. $C_{32}H_{24}N_3OPS$ requires C, 72.58; H, 4.53; N, 7.93; P, 5.86%). **4c**: mp 227°C, yellow crystals (from benzene), 62% yield; ν_{max}/cm^{-1} (KBr) 3424 (NH), 2215 (CN), 1675 (C=O); δ_H [$(CD_3)_2SO$] 4.52 (s, 1H, NH), 6.90-7.40 (m, 7H, aromatic protons), 7.50-7.95 (m, 18H, aromatic protons), 13.45 (s, 1H, NH); *m/z* 538 (Found: C, 76.0; H, 5.3; N, 10.2; P, 5.5. $C_{34}H_{27}N_4OP$ requires C, 75.83, H, 5.01; N, 10.40; P, 5.76%).

5-Ethoxy-1,2-disubstituted pyrazoles 10a-f. *General Procedure.*— To a stirred solution of **1a-f** (0.01 mol) in dry benzene (30 ml), the phosphorane **6** (3.4 g; 0.01 mol) and anhydrous potassium carbonate (2.7 g; 0.02 mol) were added. The reaction mixture were stirred 24 hours, then evaporated *in vacuo*. The remaining oil was triturated with hot petroleum ether (40-60°C) and then washed several times with petroleum ether (60-80°C). The final solid product was crystallized from benzene. **10a**: mp 190°C, red *crystals* (from benzene), 70% yield; ν_{max}/cm^{-1} (KBr) 2930-2950 (CH_3,CH_2), 1665 (C=C); δ_H [$(CD_3)_2SO$] 1.59 (t, 3H, CH_3), 4.30 (q, 2H, CH_2), 5.95 (s, 1H, pyrazole H-4); 7.05-7.10 (m, 1H, thiophene proton), 7.25-7.46 (m, 2H, thiophene protons), 7.81-8.05 (m, 4H, aromatic protons); *m/z* 315 (Found: C, 57.3; H, 4.0; N, 13.5. $C_{15}H_{13}N_3O_2S$ requires C, 57.14; H, 4.12; N, 13.33%). **10b**: mp 175°C, yellow *crystals* (from benzene), 65% yield; ν_{max}/cm^{-1} (KBr) 2950-2935 (CH_3,CH_2), 1660 (C=C); δ_H [$(CD_3)_2SO$] 1.27 (t, 3H, CH_3), 1.40 (t, 3H, CH_3), 4.25-4.45 (m, 4H, $2CH_2$); 6.47 (s, 1H, pyrazole H-4), 8.05 (d, 2H, aromatic protons); 8.35 (d, 2H, aromatic protons); *m/z* 305 (Found: C, 55.2; H, 5.1; N, 13.9. $C_{14}H_{15}N_3O_5$ requires C, 55.08, H, 4.91; N, 13.77%). **10c**: mp 94°C, yellow *crystals* (from benzene), 62% yield; ν_{max}/cm^{-1} (KBr) 3420 (NH), 2970-2930 (CH_3,CH_2), 1670 (C=O), 1665, 1660 (C=C); δ_H [$(CD_3)_2SO$] 1.45 (t, 3H, CH_3), 4.25 (q, 2H, CH_2), 6.30 (s, 1H, pyrazole H-4); 7.05-7.15 (m, 1H, aromatic proton), 7.25-7.55 (m, 5H, aromatic protons), 7.50-7.80 (m, 4H, aromatic protons); 8.75 (s, 1H, NH); *m/z* 307 (Found: C, 70.1; H, 5.5; N, 13.8. $C_{18}H_{17}N_3O_2$ requires C, 70.35, H, 5.53; N, 13.68%). **10d**: mp 56°C, yellow *crystals* (from benzene), 57% yield; ν_{max}/cm^{-1} (KBr) 2950-2930 (CH_3,CH_2), 1665, 1660 (C=C); δ_H [$(CD_3)_2SO$] 1.45 (t, 3H, CH_3), 4.25 (q, 2H, CH_2), 5.95 (s, 1H, pyrazole H-4); 7.30-7.50 (m, 5H, aromatic protons), 7.75-7.90 (m, 5H, aromatic protons); *m/z* 264 (Found: C, 77.4; H, 6.0; N, 10.8. $C_{17}H_{16}N_2O$ requires C, 77.27, H, 6.06; N, 10.60%). **10e**: mp 163°C, yellow *crystals* (from benzene), 68% yield; ν_{max}/cm^{-1} (KBr) 2970-2930 (CH_3,CH_2), 1690 (C=O), 1665, 1660 (C=C); δ_H [$(CD_3)_2SO$] 1.45 (t, 3H, CH_3), 4.25 (q, 2H, CH_2), 6.35 (s, 1H, pyrazole H-4); 7.30-7.50 (m, 6H, aromatic protons), 7.80 (d, 2H, aromatic protons), 8.40 (d, 2H, aromatic protons); *m/z* 292 (Found: C, 74.1; H, 5.6; N, 9.7; $C_{18}H_{16}N_2O_2$ requires C, 73.97, H, 5.47; N, 9.58%). **10f**: mp 156°C, orange *crystals* (from benzene), 47% yield; ν_{max}/cm^{-1} (KBr) 2950-2925 (CH_3,CH_2), 1695 (C=O), 1665, 1660 (C=C); δ_H [$(CD_3)_2SO$] 1.50 (t, 3H, CH_3), 2.60 (s, 3H, CH_3), 4.45 (q, 2H, CH_2), 6.15 (s, 1H, pyrazole H-4), 8.05 (d, 2H, aromatic protons), 8.35 (d, 2H, aromatic protons); *m/z* 275 (Found: C, 56.8; H, 4.6; N, 15.4. $C_{13}H_{13}N_3O_4$ requires C, 56.72; H, 4.72; N, 15.27%).

References

1. Nada, A. A., Erian A. W., Mohamed N. R. and Mahran A. M., *J. Chem. Res. (S)*, **1997**, 236; (M), **1997**, 1576.
2. Erian, A. W. and Mohamed, N. R., *Phosphorus, Sulfur, Silicon and Relat. Elem.*, **1998** (in press).
3. Molina, P., Arques, A., Alias, A., Vinader, M. V., *Tetrahedron*, **1992**,*48*, 3091.
4. Tewari R. S. and Parihar P.*Tetrahedron*, **1983**, *39*, 129.
5. Molina, P., Arques, A. and Alias, A.,*Tetrahedron*, **1992**,*48*, 1285.
6. Erian A. W. and Sherif S. M., *Tetrahedron Reports*, **1998** (in press).
7. Kamalov R. M., Stepanov G. S., Livinov I. A. and Pudovik M. A., *Heteroatom. Chem.*, **1994**, *5*, 469.

8. Kamalov R. M., Stepanov G. S., Chertanova L. F. and Gazikasheva A. A., *Phosphorus, Sulfur, Silicon and Relat. Elem.*, **1992**, *68*, 277.
9. Öhler E. and Zbiral E., *Chem. Ber.*,**1980**, *113*, 2326.
10. Shawali A. S. and Parkanyi C., *J. Heterocycl. Chem.*, **1980**, *17*, 833
11. Elwan N. M., Abdelhadi H. A., Abdallah T. A. and Hassaneen H. M., *Tetrahedron*, **1995**, *52*, 3451.
12. Abdelhadi H. A., Elwan N. M., Abdallah T. A. and Hassaneen H. M., *J. Chem. Res. (S)*, **1996**, 292.
13. Hassaneen H. M., Shawali A. S., Farag D. S. and Ahmed E. M., *Phosphorus, Sulfur, Silicon and Relat. Elem.*, **1996**, *53*, 113.
14. Wulff J. and Huisgen R., *Chem. Ber.* **1969**, *102*, 1841.
15. Bestmann H. J. and Kranz E., *Chem. Ber.* **1969**, *102*, 1802.
16. Huisgen R. and Wulff J., *Chem. Ber.*, **1969**, *102*, 1833.
17. Seibl, J. and Clerc, T. "Tables of Spectral Data for Structure Determination of Organic Compounds", ed. Frensenius W., Simon W. and West Th. S., Springer-Verlag Berlin Heidelberg, **1983**, p. H 360.

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