

CONJUGATED CARBODIIMIDES: PREPARATION AND THERMAL CYCLIZATION TO
2-AMINOPYRIDINE DERIVATIVES

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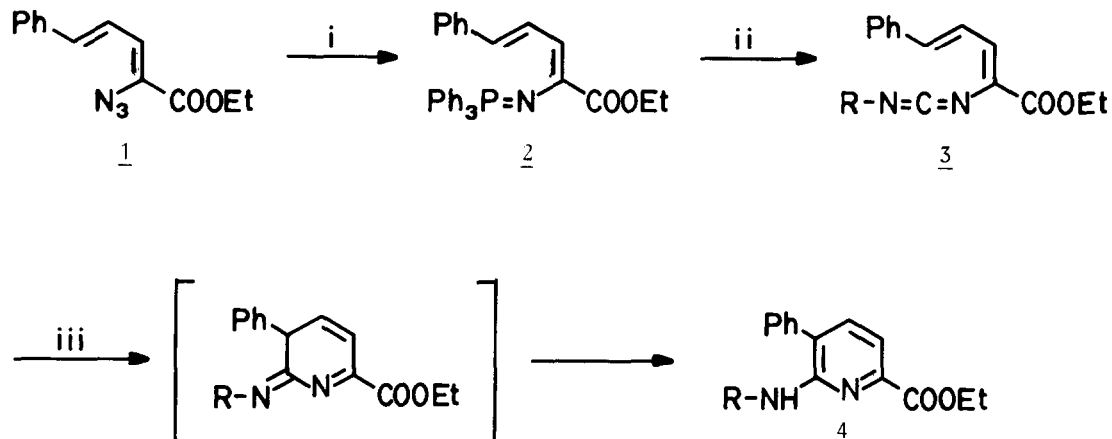
Summary: The aza-Wittig reaction of iminophosphorane (2) with isocyanates leads to conjugated carbodiimides which undergo electrocyclic ring-closure to give 2-aminopyridine derivatives.

It has become increasingly apparent that α,β -unsaturated heterocumulenes are highly useful as synthetic intermediates in preparative heterocyclic chemistry¹. Especially cycloaddition reactions of such unsaturated heterocumulenic systems e.g. ketenes, isocyanates, isothiocyanates, and ketimines provide an attractive entry to variety of heterocycles. However, the chemistry of conjugated carbodiimides has received limited attention, only the preparation of vinyl carbodiimide and some intra and intermolecular cycloaddition reactions have been reported². Continuing our interest in the iminophosphorane-mediated syntheses of heterocycles we wish to describe an useful method for the synthesis of C=C-conjugated carbodiimides (3) by an aza-Wittig reaction of iminophosphorane (2) with isocyanates, and the first synthesis of pyridines derivatives based on the electrocyclic ring-closure of carbodiimides (3).



The preparation of the desired carbodiimides (3) was accomplished very easily through the classical Staudinger reaction of ethyl 2-azido-5-phenyl-2,4-butadienecarboxylate (1) with triphenylphosphine in ether to give the iminophosphorane (2), aza-Wittig reaction of iminophosphorane (2) with isocyanates leads to carbodiimides (3), which could be isolated as viscous oils by means of short column chromatography (silica gel, dichloromethane-hexane 7:3). Upon heating in toluene (3) undergo an electrocyclic ring-closure followed by 1,3-proton shift to give the otherwise not readily available 2-aryl(alkyl)amino-6-ethoxycarbonylpyridines (4) in good yields. Mass spectra of (4) showed molecular ion peaks and the I.R. spectra exhibited N-H absorption bands at 3440-

3415 cm^{-1} . The $^1\text{H-NMR}$ spectra suggested the exocyclic N-H of (4); e.g. for (4f) the methylene signal appeared as a complex multiplet.



Reagents: i) Ph_3P /ether/r.t.; ii) R-NCO /toluene; iii) Δ

Table of physical data for the compounds (4)

Compound	R	M.p. ($^{\circ}\text{C}$)	Yield (%)
4a	C_6H_5	101-103	68
4b	$4\text{-H}_3\text{C-C}_6\text{H}_4$	96-98	86
4c	$4\text{-H}_3\text{CO-C}_6\text{H}_4$	66-67	72
4d	$4\text{-Br-C}_6\text{H}_4$	91-94	71
4e	$4\text{-Cl-C}_6\text{H}_4$	75-77	71
4f	C_2H_5	oil	79
4g	$(\text{CH}_3)_3\text{C}$	oil	69

On the other hand, iminophosphorane (2), reacts with carbon disulfide to give the corresponding isothiocyanate in 73% as crystalline solid which by heating does not undergo cyclization to the desired pyridine-thione.

The above method has the advantage of the good yields in the iminophosphorane preparation as well as cyclisation step, and the high substitution in the pyridine ring.

REFERENCES

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2. D. Zimmerman, R.A. Olofson, Tetrahedron Lett., 1970, 3453; J. Goerdder, S. Raddatz, Chem. Ber., 1980, **113**, 1095; T. Saito, M. Nakane, M. Endo, M. Yamashita, Y. Oyameda, S. Motoki, Chem. Lett., 1986, 135.
3. One-Pot Procedure:- To a solution of iminophosphorane 2 (1mmol) in dry toluene (20 ml), a solution of the appropriate isocyanate (1mmol) in the same solvent was added at room temperature. The resultant mixture was refluxed for 12h and the solvent was removed off under reduced pressure. The pyridine 4 was isolated from the residual material by sublimation.