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STUDIES OF ENAMINES. Ⅳ.[1] THE ADDITIONS OF PYRROLE AND PYRAZOLE TO ENAMINES

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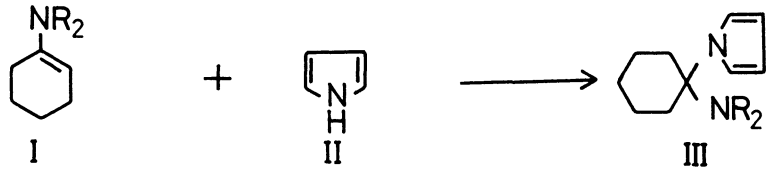
Enamines derived from cyclohexanone, propionaldehyde, and n-butyraldehyde and secondary amines react with pyrrole and pyrazole, affording new Michael type adducts respectively.

Although enamines are known to be excellent addends in many Michael type reactions, only a few examples of Michael type additions to enamines have hitherto been reported. The additions of mercapto compounds,[2,3] alcohols,[4] hydrazoic acid,[5] and phosphinyldiazomethanes[6] to enamines afford the corresponding Michael type adducts, respectively (Eq. 1). We now wish to report the reactions of enamines with pyrrole and pyrazole leading to the formation of new Michael type adducts.

$$\geq N\text{-}\underset{|}{C}\text{=}C\leq \quad + \quad HY \longrightarrow \geq N\text{-}\underset{\underset{Y}{|}}{C}\text{-}CH\leq \qquad \text{(Eq. 1)}$$

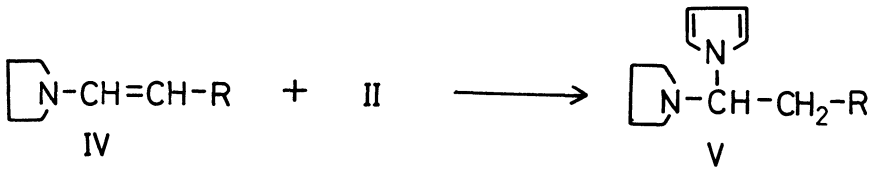
When a mixture of an equimolar amount of 1-(1-pyrrolidinyl)cyclohexene (Ia) and pyrrole (Ⅱ) was heated at 60°C for 5 min, a 1:1 adduct Ⅲa was obtained in a fairly good yield. The ir spectrum of Ⅲa showed no characteristic absorption bands ascribable to an enamine structure and also NH. In its nmr spectrum no methine and olefinic protons were displayed, and α- and β-protons of pyrrolyl group were observed as two double doublets (each 2H) besides methylene protons (18H) of cyclohexyl and pyrrolidinyl groups. Thus Ⅲa is concluded to be 1-(1-pyrrolidinyl)-1-(1-pyrrolyl)cyclohexane.

Similarly, 1-morpholino- (Ib), 1-piperidinocyclohexene (Ic), 1-(1-pyrrolidinyl)propene (Ⅳa), and 1-(1-pyrrolidinyl)-1-butene (Ⅳb) reacted with Ⅱ to afford the corresponding Michael type adducts, Ⅲb, Ⅲc, Va, and Vb, respectively. The structures of all adducts were confirmed on the basis of their spectral data and microanalyses.



I + II → III

a: NR_2=1-pyrrolidinyl; b: NR_2=morpholino; c: NR_2=piperidino

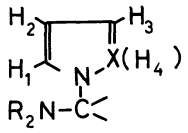


IV + II → V

a: R=Me; b: R=Et

The reaction conditions, yields, and physical properties of Ⅲ and V are given in Table I.

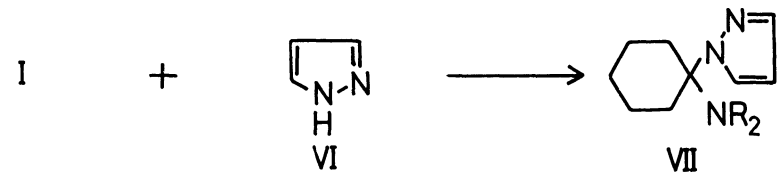
TABLE I



Reactant		Reaction conditions[a] Time	Temp. (°C)	Solvent	Adduct[b]	X	Yield (%)	Mp. (°C)	Nmr, δ (ppm)[c] H_1	H_2	H_3	H_4
Ia	II	5 min	60	------	IIIa	CH	75	57-58	6.65	5.91	5.91	6.65
Ib	II	2 hr	reflux	MeOH	IIIb	CH	26	79-80	6.65	5.93	5.93	6.65
Ic	II	2 hr	80	------	IIIc	CH	54	59	6.65	5.94	5.94	6.65
IVa	II	5 min	80	------	Va[d]	CH	42	liq.	6.58	5.98	5.98	6.58
IVb	II	20 min	85	------	Vb[e]	CH	71	liq.	6.58	5.97	5.97	6.58
Ia	VI	12 hr	20	Et_2O	VIIa	N	87.5	41	7.45	6.15	7.45	----
Ib	VI	48 hr	20	Et_2O	VIIb	N	92.5	72-73	7.59	6.31	7.62	----
Ic	VI	5 min	85	------	VIIc	N	100	68	7.38	6.15	7.55	----

a) The reaction conditions shown here were the optimum conditions for the formation of adducts. b) Satisfactory analyses were given for all adducts. All III and VII are colorless needles. c) Nmr spectra were measured in CCl_4 solution using TMS as an internal reference. The α- (H_1, H_4) and β-protons (H_2, H_3) in the pyrrolyl rings of III and V appeared as double doublets (J=1.5 and 2.0 Hz), respectively. It has been reported that α- and β-protons in 1-methylpyrrole appeared at δ 6.37 and 5.92 ppm, and 3-, 4-, and 5-proton in 1-methylpyrazole appeared at δ 7.30, 6.10, and 7.22 ppm, respectively (T. J. Batterham, "NMR Spectra of Simple Heterocycles", John Wiley & Sons, New York, 1973, p. 146). d) Va: colorless liq. Bp. 75°C (2 mmHg). e) Vb: colorless liq. Bp. 82-87°C (2 mmHg). Picrate: mp 130°C (decomp.).

The reaction of cyclohexanone enamines (Ia-Ic) with pyrazole (VI) afforded the corresponding Michael type adducts, VIIa-VIIc, in good yields, whose structures were confirmed on the basis of their spectral data and microanalyses.



a: NR_2=1-pyrrolidinyl; b: NR_2=morpholino; c: NR_2=piperidino

The reaction conditions, yields, and physical properties of VII are also given in Table I.

REFERENCES

* Author to whom correspondence and inquires should be addressed.

1) Part III of this series: O. Tsuge and A. Inaba, Bull. Chem. Soc. Japan, 46, 2221 (1973).

2) S.-O. Lawesson, E. H. Larsen, and H. J. Jakobsen, Rec. Trav. Chim. Pays-Bas, 83, 461 (1964).

3) P. Klemmensen and S.-O. Lawesson, Chem. Commun., 1968, 205.

4) F. Garcia Jimenez and F. Huerta Valencia, Rev. Latinoamer. Quim., 1971, 61; Chem. Abstr., 76, 25010k (1972).

5) G. Opitz, A. Griesinger, and H. W. Schubert, Ann. Chem., 665, 91 (1963).

6) W. Welter and M. Regitz, Tetrahedron Lett., 1972, 3799.

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