General Synthesis of 1a,7b-Dihydro-1*H*-cyclopropa[*c*]cinnolines with Electron-Withdrawing Substituents in the 1a-Position

Luisa Garanti and Gaetano Zecchi

Istituto di Chimica Industriale dell' Università, Centro del C.N.R. per la Sintesi e Stereochimica di Speciali Sistemi Organici, 20133 Milano, Italy

Received July 26, 1978

2-Vinylphenylhydrazonyl chlorides (**4**) react with triethylamine in boiling benzene to afford the title compounds (**6**) in 54-72% yield, probably through nitrile imine intermediates (**5**).

J. Heterocyclic Chem., 16, 377 (1979).

We have reported the synthesis and chemical reactions of few 1a-carbethoxy-1a,7b-dihydro-1*H*-cyclopropa[*c*]-cinnolines, the first representatives of a new type of benzofused diazanorcaradienes (1-3). Aiming toward a more extensive study of this novel ring system, efforts have been devoted to the preparation of substrates with a wider variety of substituents in the 1a-position. The synthesis of compounds **6a-e** is here described.

As illustrated in the Scheme, the reaction sequence leading to **6a-e** involves: (i) diazotization of the *ortho*-substituted anilines **1**; (ii) coupling of the corresponding diazonium salts **2** with the properly 1-substituted 1-chloro-2-propanones **3**, and (iii) treatment of the phenylhydrazonyl chlorides **4** with triethylamine in boiling benzene. Tables I and II collect reaction times and yields as well as physical, spectral, and analytical data of the new compounds.

The stereochemistry of **6a-c** is unequivocally shown by the nmr spectra; in fact, the observed chemical shifts (in the range δ 0.6-0.8) are only consistent with the methyl group close to the shielding region of the π electron system, *i.e.*, in the *endo* position. The same configuration is suggested for **6d,e** by the nmr signals of the aromatic protons, part of which are shielded up to δ 6.5-6.6. Thus, the retentionof stereochemistry would seem a general feature of the cyclization process leading to **6**.

In view of the usual behaviour of hydrazonyl chlorides in basic medium (4), nitrile imines **5** can be conceived as primary intermediates in the reaction **4** → **6**, the final products being formed through an intramolecular cheletropic addition to the ethylenic bond. Since previous examples of such a reaction concern nitrile imines bearing a carbethoxy group on the carbene-like carbon (1), the results here reported appear to be of great importance as they speak in favour of the generality of this intramolecular mode of cycloaddition. Aiming to the full understanding of it, hydrazonyl chlorides with electron-donating R_2 substituents would be desirable; however, this kind of substitution precludes the coupling reaction between **2** and **3**.

EXPERIMENTAL

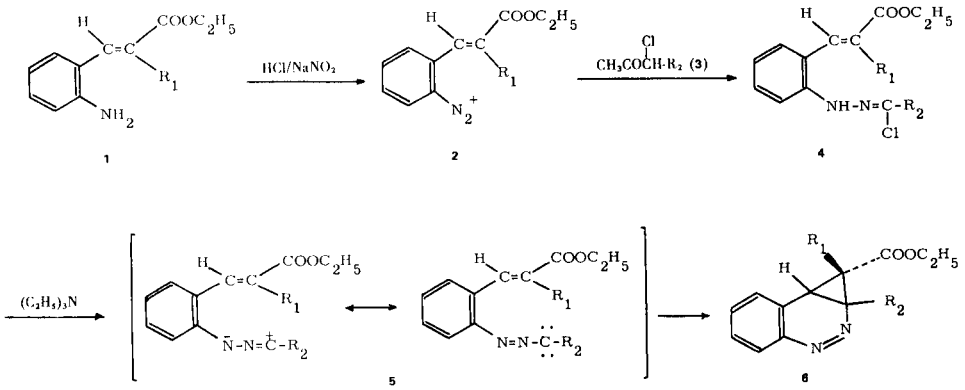
Melting points were taken on a Büchi apparatus and are uncorrected. Nmr spectra were recorded on a Varian A-60A instrument with TMS as an internal standard. Ir spectra were measured on a Perkin-Elmer Model 377 spectrophotometer. Organic solutions were dried over anhydrous sodium sulphate.

Compounds **3** were prepared according to the following references: R_2 = CH_3CO (5), C_6H_5CO (6), $C_6H_5SO_2$ (7), and 4-$NO_2C_6H_4$ (8).

General Procedure for the Preparation of Phenylhydrazonyl Chlorides (**4**).

Sodium nitrite (14 mmoles) in water (10 ml.) was added to a solution of amine **1** (1) (14 mmoles) in 2 *N* hydrochloric acid (35 ml.) with stirring and ice-cooling. The mixture was then adjusted to *p*H 4 by sodium acetate and compound **3** (14 mmoles) in methanol (5 ml.) was added dropwise under vigorous stirring at 0-5°. After 3 hours at room temperature, the mixture

Scheme



0022-152X/79/020377-03$02.25

Table I

Preparation of Phenylhydrazonyl Chlorides (**4**)

Compound No	R_1	R_2	Yield %	M.p. °C	Ir, cm^{-1} (nujol)	Nmr, δ (deuteriochloroform)	*Anal.*	Calcd.	Found
4a	CH_3	CH_3CO	45	102-103	3280 1700 1680	1.35 (3H, t), 1.94 (3H, d, J *ca.* 1 Hz), 2.54 (3H, s), 4.27 (2H, q), 7.0-7.6 (5H, m), 8.3 (1H, broad s)	C, H, N,	58.34 5.56 9.07	58.56 5.39 8.87
4b	CH_3	C_6H_5CO	43	107-108	3330 1700 1660	1.37 (3H, t), 1.97 (3H, d, J *ca.* 1 Hz), 4.30 (2H, q), 7.1-8.2 (10H, m), 8.4 (1H, broad s)	C, H, N,	64.77 5.17 7.56	64.55 5.30 7.61
4c	CH_3	$4\text{-}NO_2C_6H_4$	46	122-123	3330 1720	1.40 (3H, t), 2.01 (3H, d, J *ca.* 1 Hz), 4.33 (2H, q), 7.0-8.4 (9H, m), 8.5 (1H, broad s)	C, H, N,	58.83 4.69 10.84	58.65 4.90 10.73
4d	C_6H_5	CH_3CO	58	98-99	3280 1700 1670	1.30 (3H, t), 2.45 (3H, s), 4.35 (2H, q), 6.9-7.5 (9H, m), 7.88 (1H, s), 8.4 (1H, broad s)	C, H, N,	64.77 5.17 7.56	64.93 4.95 7.38
4e	C_6H_5	$C_6H_5SO_2$	25	123-125	3350 1710	1.29 (3H, t), 4.30 (2H, q), 6.8-8.1 (15H, m), 8.3 (1H, broad s)	C, H, N,	61.46 4.52 5.98	61.71 4.53 5.71

Table II

Preparation of 1a,7b-Dihydro-1*H*-cyclopropa[*c*]cinnolines (**6**)

Compound No.	R_1	R_2	Reaction Time Hours	Yield %	M.p. °C	Ir, cm^{-1} (nujol)	Nmr, δ (deuteriochloroform)	*Anal.*	Calcd.	Found
6a	CH_3	CH_3CO	3	54	80	1735 1710	0.60 (3H, s), 1.32 (3H, t), 2.80 (3H, s), 3.81 (1H, s), 4.26 (2H, q), 7.0-8.4 (4H, m)	C, H, N,	66.16 5.92 10.29	66.25 5.77 10.40
6b	CH_3	C_6H_5CO	3	55	119	1725 1690	0.77 (3H, s), 1.00 (3H, t), 3.90 and 3.98 (3H, s and q), 7.4-8.5 (9H, m)	C, H, N,	71.84 5.43 8.38	71.98 5.37 8.22
6c	CH_3	$4\text{-}NO_2C_6H_4$	0.5	65	130	1725	0.75 (3H, s), 1.00 (3H, t), 3.94 and 3.96 (3H, q and s), 7.4-8.5 (8H, m)	C, H, N,	64.95 4.88 11.96	65.10 4.68 12.01
6d	C_6H_5	CH_3CO	1	72	162	1730 1710	1.20 (3H, t), 2.97 (3H, s), 3.9-4.3 (3H, overlapping signals), 6.6-7.9 (9H, m)	C, H, N,	71.84 5.43 8.38	71.59 5.41 8.49
6e	C_6H_5	$C_6H_5SO_2$	7	65	180	1730	1.24 (3H, t), 4.26 and 4.32 (3H, q and s), 6.5-8.3 (14H, m)	C, H, N,	66.64 4.67 6.48	66.87 4.49 6.29

was extracted with ether, and the organic layer was dried and evaporated. Recrystallization of the residue from diisopropyl ether-ethanol usually gave **4** in the pure state. The only exception was **4e** which was isolated by chromatography on a silica gel column (300 g.) with diethyl ether-light petroleum (1:1) as eluent (See Table I).

General Procedure for the Preparation of 1a,7b-Dihydro-1*H*-cyclopropa[*c*]cinnolines (**6**).

A solution of **4** (5 mmoles) and triethylamine (25 mmoles) in benzene (50 ml.) was refluxed for the time indicated in Table II. The solid product was filtered off and the solution was absorbed onto a silica gel column (150 g.). Elution with diethyl ether containing 5% of triethylamine gave pure **6** (See Table II).

REFERENCES AND NOTES

(1) L. Garanti and G. Zecchi, *J. Chem. Soc., Perkin Trans. I*, 2092 (1977).

(2) L. Garanti and G. Zecchi, *J. Heterocyclic Chem.*, **15**, 509 (1978).

(3) L. Garanti and G. Zecchi, *J. Chem. Soc., Perkin Trans. I*, in press.

(4) R. Huisgen, *Angew. Chem., Int. Ed. Engl.*, **2**, 565 (1963).

(5) A. K. Macbeth, *J. Chem. Soc.*, **121**, 1116 (1922).

(6) A. K. Macbeth, *ibid.*, **123**, 1122 (1923).

(7) L. Chiodini, L. Garanti and G. Zecchi, *Synthesis*, in press.

(8) F. G. Bordwell and R. G. Scamehorn, *J. Am. Chem. Soc.*, **90**, 6751 (1968).