Notizen

v-Triazolines, XXVI[1]

1,2,5-Trisubstituted 3-Pyrrolecarbaldehydes from *N*-Substituted Oxazolium-5-olates and 5-Amino-4,5-dihydro-4-methylene-*v*-triazoles

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v-Triazoline, XXVI[1]

1,2,5-Trisubstituierte 3-Pyrrolcarbaldehyde aus *N*-substituierten Oxazolium-5-olaten und 5-Amino-4,5-dihydro-4-methylen-*v*-triazolen

Die Cycloaddition von einigen symmetrisch und unsymmetrisch substituierten *N*-substituierten Oxazolium-5-olaten (**2**) an 5-Amino-4,5-dihydro-4-methylen-*v*-triazole (**1**) wird beschrieben. Durch regiospezifische Cycloaddition entstehen instabile Cycloaddukte, die sofort Kohlendioxid und Stickstoff unter Umlagerung zu 1,2,5-trisubstituierten 3-Pyrrolcarbaldehyd-anilen (**3**) eliminieren. Die Anile werden leicht zu den entsprechenden 1,2,5-trisubstituierten 3-Pyrrolcarbaldehyden (**4**) hydrolysiert.

The readily accessible 5-amino-1-aryl-4,5-dihydro-4-methylene-*v*-triazoles have been demonstrated to be valuable substrates for cycloaddition reactions with some 1,3-dipoles[2-5] and cyclic 1,3-dienes[6]. With the exception of diazoalkanes[3], which afforded spiro cycloadducts containing the 4,5-dihydro-*v*-triazole ring, other 1,3-dipoles gave unstable cycloaddition products which underwent immediate cleavage of the dihydrotriazole ring accompanied by nitrogen evolution and rearrangement to give oxazine and pyrazole derivatives, respectively.

The cycloaddition reactions of nitrile oxides[2] and nitrile imines[4] were characterized by a high regioselectivity and afforded a single type of regioisomer. On the other hand the mesoionic sydnones[5], though giving a single regioisomer, showed an orientation which was dependent on the absence or presence of a substituent on C-4. Mesoionic *N*-substituted oxazolium-5-olates ("Münchnones"[7]) are reactive 1,3-dipoles of the azomethyne ylide type whose chemistry has been extensively developed by *Huisgen* and coworkers[7-13], and we were interested in studying their behaviour with respect to 4,5-dihydro-4-methylene-*v*-triazoles both to get further information about the regiochemistry of cycloadditions involving these heterocyclic substrates and to have an access to substituted pyrrole derivatives.

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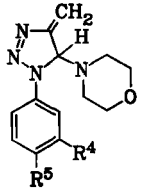
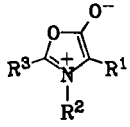
A. Cycloaddition Reactions of Symmetrically Substituted Oxazolium-5-olates

The crystalline oxazolium-5-olate **2a**[7] and the dihydro-*v*-triazole derivative **1a** rapidly reacted in the 2:1 molar ratio at room temperature resulting in the formation of 1-methyl-2,5-diphenyl-3-pyrrolecarbaldehyde (**4a**), the corresponding 3-(trifluoromethyl)anil **3a**, and *N*-benzoyl-*N*-methylphenylglycine morpholide. The reaction was normally complete within 0.5 hours. During the reaction carbon dioxide and nitrogen were evolved. Product **3a** was readily separated from the reaction mixture through crystallization, and **4a** was obtained from the mother liquor by adding excess benzaldehyde to completely decompose the anil present followed by chromatographic separation. The overall yield of products **3a** and **4a** was 75%. Small amounts of unreacted starting materials, morpholine, and 3-(trifluoromethyl)aniline were also found in the crude reaction mixture (GC and TLC). Compound **4a** was easily identified from its analytical data and ^{1}H NMR spectrum which showed three typical singlets at δ = 3.52 (NCH_3), 6.77 (4-H), and 9.60 (CHO) which all are a good agreement with known values for pyrrole derivatives[14]. In the IR spectrum the aldehyde group is associated with the low-wavenumber band (1645 cm^{-1}) which is expected for 3-pyrrolecarbaldehydes[15]. Compound **4a** was also prepared by independent synthesis[16]. The structure of **3a**, which shows typical IR bands (1610 cm^{-1}, CH=N) and ^{1}H NMR signals (δ = 3.52 NCH_3; 6.98 4-H; 8.12 CH=N), was clearly established by its transformation into **4a** by reaction with benzaldehyde and its ready formation from **4a** and 3-(trifluoromethyl)aniline.

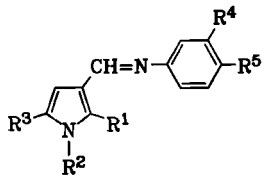
Similar results were obtained by reacting **1a** or **1b** with oxazolium-5-olates **2d**, **e**, and **f**, respectively. In every case the rather unstable **2** were isolated, but were used without further purification. The crude reaction mixtures contained invariably both the corresponding anils



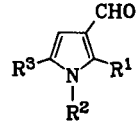
	R^4	R^5
1a	CF_3	H
b	H	NO_2



2a–i



	R^1	R^2	R^3	R^4	R^5
3a	C_6H_5	CH_3	C_6H_5	CF_3	H
b	CH_3	CH_3	C_6H_5	H	NO_2



4a–i

2, 4	R^1	R^2	R^3
a	C_6H_5	CH_3	C_6H_5
b	C_6H_5	CH_3	$C_6H_4OCH_3$–(4)
c	C_6H_5	CH_3	C_6H_4Cl–(2)
d	$C_6H_4OCH_3$–(4)	CH_3	$C_6H_4OCH_3$–(4)
e	C_6H_5	C_2H_5	C_6H_5

2, 4	R^1	R^2	R^3
f	C_6H_5	C_6H_5	C_6H_5
g	$C_6H_4OCH_3$–(4)	CH_3	C_6H_5
h	C_6H_5	CH_3	CH_3
i	CH_3	CH_3	C_6H_5

3 (^{1}H NMR singlet in the δ = 8.15 region) and aldehydes **4** (^{1}H NMR singlet in the δ = 9.5 region). They were reacted directly with excess benzaldehyde to isolate (by chromatography) the pure 3-pyrrolecarbaldehydes (**4d, e, f**).

B. Cycloadditions of Unsymmetrically Substituted Oxazolium-5-olates

Oxazolium-5-olates **2b, c, g–i** were used to get information about the regioselectivity of the cycloaddition reaction. Compound **1b** reacted smoothly both with **2h** and **i** affording a mixture of 3-pyrrolecarbaldehyde and the corresponding anil. From **1b** and **2h** only the aldehyde **4h** was isolated as a pure compound (78% yield) after decomposition of the anil which was also present in the crude reaction mixture. On the other hand, starting from **1b** and **2i** both **3b** and **4i** could be obtained as pure compounds (23 and 45% yield, resp.). Quite interestingly, in either case a single regioisomer was produced. The structures of compounds **4h** and **i** were assigned unambiguously through a comparative study of their ^{1}H NMR spectra. Aldehyde **4h** shows singlets associated with the two methyl substituents, the ring hydrogen atom, and the formyl group which are all shifted to higher field with respect to **4i**. Molecular models clearly evidence that in **4h** the phenyl ring is obliged by substituent crowding in a conformation appreciably perpendicular to the pyrrole ring, thus shielding both the *N*-methyl and the formyl groups. In the less crowded **4i** the aromatic substituent is nearly coplanar with the pyrrole ring and deshields the neighbouring methyl and H substituents. With respect to **4h**, the signal of the 2-methyl group in **4i** is shifted to lower field by the dishielding effect of the adjacent carbonyl substituent. Further support to these assignments is given by the good agreement of the shift values for the *N*-methyl, formyl, and hydrogen substituents in **4h** and **a**.

The unsymmetrically substituted mesoionic compounds **2b, c,** and **g**, too, afforded a single regioisomer (**4b, c,** and **g**, resp.) on reaction with **1a**. Their structures were assigned by analogy with **4h** and **i** assuming that the same regiochemical rules were operating.

The formation of products **3** is logically explained by the rearrangement of a cycloaddition product of **2** to **1** accompanied by CO_2 and N_2 elimination. The intermediate cycloadduct is supported both by the well documented ability of both reactants to undergo cycloaddition processes and their thermal stability under the reaction conditions.

The regioselectivity appears to be quite high since products **3** and/or **4** were isolated in 65–90% yields and ^{1}H NMR and TLC analysis of the crude reaction mixtures failed to evidence detectable amounts of other regioisomeric products.

The behaviour of münchnones is thus analogous to that of nitrile oxides[2] and nitrile imines[4] which all yield products in which the (formally) positive end of the dipole becomes linked to the methylene carbon of **1**.

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Experimental Part

IR spectra: Perkin-Elmer 197 Infrared Spectrophotometer. – ^{1}H NMR spectra (tetramethylsilane as internal standard): Varian 360 A instrument. – TLC: ready-to-use silica gel plates with benzene/ethyl acetate (1:9–9:1) as eluent. – Column chromatography: silica gel with the eluent indicated. – Melting points: not corrected.

v-Triazolines

The 4-methylene-5-morpholino-*v*-triazoline **1b** has been described previously[17]. **1a** (m.p. 85°C) was obtained similarly.

N-Substituted Oxazolium-5-olates

Compounds **2a, b**, and **g** have been already described[7].

2-(2-Chlorophenyl)-3-methyl-4-phenyloxazolium-5-olate (**2c**): *N*-Methyl-*C*-phenylglycine hydrochloride[18] (23.0 g, 110 mmol) was suspended in 10% NaOH (137 ml). The solution of 2-chlorobenzoyl chloride (22.3 g, 120 mmol) in CCl_4 (20 ml) was added under vigorous stirring at room temperature. Stirring was continued for 2 h and the reaction mixture was acidified to pH 2 with 10% HCl. The oily precipitate was separated, diluted with $CHCl_3$ (150 ml), the solution was dried over Na_2SO_4 and evaporated. The residue was dissolved in the minimum amount of benzene and precipitated by adding *n*-hexane, m.p. 110–111 °C, yield 20.8 g (62%). – IR (Nujol): 1725, 1635 cm^{-1} (C=O). – ^1H NMR ($CDCl_3$): δ = 2.67 (s, 3H, NCH_3); 6.27 (s, 1H, CH); 7.15–7.55 (m, 9 aromat. H and OH).

$C_{16}H_{14}ClNO_3$ (303.7) Calcd. C 63.26 H 4.65 N 4.61 Found C 62.95 H 4.55 N 4.54

The 2-chlorobenzoylated *N*-methyl-*C*-phenylglycine (6.0 g, 19 mmol) was dissolved in CH_2Cl_2 (100 ml) and dicyclohexylcarbodiimide (DCCD) (4.15 g, 19 mmol) was added. The reaction mixture was stirred for 2 h. The precipitated dicyclohexylurea was filtered and the filtrate was used directly for the reaction with **1**.

2,4-Bis(4-methoxyphenyl)-3-methyloxazolium-5-olate (**2d**): The hitherto unknown *C*-(4-methoxyphenyl)-*N*-methylglycine hydrochloride was prepared similar to *N*-methyl-*C*-phenylglycine[18] starting from 4-methoxybenzaldehyde and methylamine hydrochloride, m.p. 228 °C, yield 51%. – IR (Nujol): 1730 cm^{-1} (C=O).

$C_{10}H_{14}ClNO_3$ (231.7) Calcd. C 51.83 H 5.56 N 6.04 Found C 51.65 H 5.95 N 6.04

As **2c** from *C*-(4-methoxyphenyl)-*N*-methylglycine hydrochloride (20.4 g, 88 mmol) and 4-methoxybenzoyl chloride (16.7 g, 98 mmol). The glassy 4-methoxybenzoyl derivative [18.3 g, 70% yield, IR (Nujol): 1715, 1605 cm^{-1} (C=O); ^1H NMR ($CDCl_3$): δ = 2.91 (s, 3H, NCH_3); 4.88 (s, 6H, OCH_3); 6.28 (s, 1H, CH); 6.71–7.09 (m, 8 aromat. H and OH)] was suspended in acetic anhydride (72 ml) and heated at 50–55 °C for 10 min. The solution was evaporated under reduced pressure, the residue was taken up in ether, filtered, and the solid residue was heated in boiling acetonitrile (180 ml) and filtered, m.p. 140–141 °C, yield 10.2 g (60%). – IR (Nujol): 1690 (C=O), 1600 cm^{-1}. – ^1H NMR ($CDCl_3$): δ = 3.79 (s, 6H, OCH_3); 3.85 (s, 3H, NCH_3); 6.7–7.7 (m, 8 aromat. H).

$C_{18}H_{17}NO_4$ (311.3) Calcd. C 69.44 H 5.50 N 4.50 Found C 69.35 H 5.63 N 4.29

3-Ethyl-2,4-diphenyloxazolium-5-olate (**2e**): The hitherto unknown *N*-ethyl-*C*-phenylglycine hydrochloride was prepared similar to *N*-methyl-*C*-phenylglycine[18] starting from benzaldehyde and ethylamine hydrochloride, m.p. 188–189 °C, yield 51%. – IR (Nujol): 3360–3300 (NH_2), 1725 cm^{-1} (C=O). – ^1H NMR (D_2O): δ = 1.32 (t, 3H, CH_3); 3.01 (q, 2H, CH_2); 5.1 (s, 1H, CH); 7.4–7.6 (m, 5 aromat. H).

$C_{10}H_{14}ClNO_2$ (215.7) Calcd. C 55.69 H 6.54 N 6.49 Found C 55.48 H 6.72 N 6.12

N-Ethyl-*C*-phenylglycine hydrochloride (10 g, 46 mmol) was benzoylated with benzoyl chloride (12.6 g, 89 mmol) in sodium hydroxide (7.4 g, in 75 ml of water) by stirring at room temp. for 5 h. The oily product [14.3 g, 65% yield; IR (Nujol): 1740, 1590 cm^{-1} (C=O); ^1H NMR ($CDCl_3$): δ = 0.92 (t, 3H, CH_3); 3.40 (q, 2H, CH_2); 5.80 (s, 1H, CH); 7.1–8.2 (m, 10 aromat. H and OH)] was suspended in acetic anhydride (32 ml) and heated at 50 °C for 10 min. After evaporation at reduced pressure the residue was taken up with ether, filtered, dissolved in acetonitrile and precipitated with ethyl ether, m.p. 85–86 °C, yield 16.8 g (72%). The product could not be purified further owing to its unstability. – IR (Nujol): 1695

(C=O), 1590 cm^{-1}. – ^1H NMR ($CDCl_3$): δ = 1.3 (t, 3H, CH_3); 4.37 (q, 2H, CH_2), 7.2–8.25 (m, 10 aromat. H).

2,3,4-Triphenyloxazolium-5-olate (**2f**): *N*-Benzoyl-*N,C*-diphenylglycine[19] (1.5 g, 4.1 mmol) was suspended in acetic anhydride (6 ml) and heated at 50°C for 10 min. After evaporation at reduced pressure, the residue was taken up in ether, filtered, and the solid residue was heated in boiling acetonitrile (30 ml) and filtered, m.p. 202–204°C, yield 1.1 g (77%). – IR (Nujol): 1705 cm^{-1} (C=O).

$C_{21}H_{15}NO_2$ (313.3) Calcd. C 80.49 H 4.82 N 4.47 Found C 80.19 H 4.69 N 4.43

2,3-Dimethyl-4-phenyloxazolium-5-olate (**2h**): *N*-Acetyl-*N*-methyl-*C*-phenylglycine[8] (3.0 g, 14 mmol) was reacted with DCCD (3.0 g, 14 mmol) in CH_2Cl_2 (50 ml) at room temp. for 2 h. The reaction mixture was filtered and the filtrate used directly.

3,4-Dimethyl-2-phenyloxazolium-5-olate (**2i**): As **2h** from *N*-benzoyl-*N*-methylalanine[8].

3-Pyrrolecarbaldehydes and 3-Pyrrolecarbaldehyde Anils

General Procedure: The dihydrotriazole **1** was dissolved or suspended in the reaction solvent and reacted at room temp. by adding solid oxazolium-5-olate **2**. Alternatively the solid dihydrotriazole **1** was added to the solution of the oxazolium-5-olate. Stirring was continued for 0.5 h and the end of the reaction checked by TLC. The solvent was evaporated and the residue redissolved in ethyl acetate/cyclohexane (2:3). The solution was filtered through a short column of silica gel (40–50 g). The filtrate was evaporated and the residue elaborated according to method a) or b).

a) The residue was crystallized from methanol affording compound **3** and the mother liquor was evaporated, the residue dissolved in benzene (10–15 ml), and a molar amount (with respect to starting **1**) of benzaldehyde was added. The solution was reacted overnight, then evaporated and chromatographed on a silical gel column with petrol ether (b.p. 40–60°C) which was gradually mixed with CH_2Cl_2 until using pure CH_2Cl_2. The main fraction was evaporated and the residue recrystallized to produce pure **4**.

b) The residue was directly reacted with benzaldehyde and elaborated as described in a), affording pure **4**.

1-Methyl-2,5-diphenyl-3-pyrrolecarbaldehyde (**4a**) *and 1-Methyl-2,5-diphenyl-3-[[3-(trifluoromethyl)phenylimino]methyl]pyrrole* (**3a**): From 1.6 g (5.0 mmol) of triazoline **1a** and 2.6 g (10 mmol) of oxazolium-5-olate **2a** in acetonitrile (15 ml). Work-up according to a).

3a: From methanol 0.20 g (10%), yellow crystals, m.p. 115–116°C. – IR (Nujol): 1610 cm^{-1} (C=N). – ^1H NMR ($CDCl_3$): δ = 3.52 (s, 3H, CH_3); 6.98 (s, 1H, 4-H); 7.1–7.6 (m, 14 aromat. H); 8.12 (s, 1H, CH=).

$C_{25}H_{19}F_3N_2$ (404.4) Calcd. C 74.24 H 4.73 N 6.93 Found C 73.84 H 4.58 N 6.69

4a: From acetonitrile 0.85 g (65%), m.p. 126°C. – IR (Nujol): 1645 cm^{-1} (C=O). – ^1H NMR ($CDCl_3$): δ = 3.52 (s, 3H, CH_3); 6.77 (s, 1H, 4-H); 7.1–7.55 (m, 10 aromat. H); 9.60 (s, 1H, CHO). – This product was identical with an independently synthesized sample (m.p. 126°C)[16].

$C_{18}H_{15}NO$ (261.3) Calcd. C 82.72 H 5.78 N 5.36 Found C 82.54 H 5.77 N 5.51

5-(4-Methoxyphenyl)-1-methyl-2-phenyl-3-pyrrolecarbaldehyde (**4b**): From 2.18 g (7.0 mmol) of **1a** and 4.0 g (14 mmol) of **2b** in acetonitrile (20 ml) and elaboration according to method b). From methanol 1.4 g (68%), m.p. 105–106°C. – IR (Nujol): 1645 cm^{-1}

(C=O). – ^{1}H NMR ($CDCl_3$): δ = 3.42 (s, 3H, NCH_3); 3.82 (s, 3H, OCH_3); 6.7 (s, 1H, 4-H); 6.75–7.65 (m, 9 aromat. H); 9.57 (s, 1H, CHO).

$C_{19}H_{17}NO_2$ (291.3) Calcd. C 78.32 H 5.88 N 4.80 Found C 77.92 H 5.52 N 4.64

5-(2-Chlorphenyl)-1-methyl-2-phenyl-3-pyrrolecarbaldehyde (**4c**): By reacting 1.3 g (3.3 mmol) of **1a** and 2.0 g (6.6 mmol) of **2c** in CH_2Cl_2 (35 ml) and elaborating according to method b). Oil which decomposed on attempted distillation, 1.4 g (81%). – IR (Nujol): 1654 cm^{-1} (C=O). – ^{1}H NMR ($CDCl_3$): δ = 3.27 (s, 3H, CH_3); 6.70 (s, 1H, 4-H); 7.1–7.6 (m, 9 aromat. H); 9.56 (s, 1H, CHO).

4-Nitrophenylhydrazone: M. p. 250–252°C, after extraction with hot acetonitrile.

$C_{22}H_{19}ClN_4O_2$ (430.8) Calcd. C 66.90 H 4.44 N 13.00
Found C 67.31 H 4.37 N 13.21

2,5-Bis(4-methoxyphenyl)-1-methyl-3-pyrrolecarbaldehyde (**4d**): From **1a** (2.0 g, 6.9 mmol) and **2d** (4.3 g, 13.8 mmol) in acetonitrile (30 ml). Elaboration according to method b). From ethanol or acetonitrile 0.90 g (69%), m. p. 128–129°C. – IR (Nujol): 1640 cm^{-1} (C=O). – ^{1}H NMR ($CDCl_3$): δ = 3.40 (s, 3H, NCH_3); 3.90 (s, 6H, OCH_3); 6.6–7.5 (m, 8 aromat. H); 9.52 (s, 1H, CHO).

$C_{20}H_{19}NO_3$ (321.4) Calcd. C 74.74 H 5.95 N 4.36 Found C 74.81 H 6.04 N 4.42

1-Ethyl-2,5-diphenyl-3-pyrrolecarbaldehyde (**4e**): From 2.0 g (6.4 mmol) of **1a** and 3.39 g (12.8 mmol) of **2e** in acetonitrile (30 ml). Elaboration according to method b). Oil (decomposed on attempted distillation), 1.2 g (68%). – IR (Nujol): 1650 cm^{-1} (C=O). – ^{1}H NMR ($CDCl_3$): δ = 0.98 (t, 3H, CH_3); 4.01 (q, 2H, CH_2); 7.73 (s, 1H, 4-H); 7.25–7.6 (m, 10 aromat. H); 9.53 (s, 1H, CHO).

4-Nitrophenylhydrazone: M. p. 225–226°C (extracted with hot acetonitrile).

$C_{25}H_{22}N_4O_2$ (410.5) Calcd. C 73.15 H 5.40 N 13.65 Found C 72.86 H 5.39 N 13.52

1,2,5-Triphenyl-3-pyrrolecarbaldehyde (**4f**): By reacting 0.90 g (3.1 mmol) of **1b** and 1.1 g (3.5 mmol) of **2f** in acetonitrile (20 ml) and elaborating according to method b). From cyclohexane 0.90 g (89%), m.p. 245°C. – IR (Nujol): 1655 cm^{-1} (C=O). – ^{1}H NMR ($CDCl_3$): δ = 6.80–7.45 (m, 15 aromat. H); 9.70 (s, 1H, CHO).

$C_{23}H_{17}NO$ (323.0) Calcd. C 85.45 H 5.26 N 4.33 Found C 85.60 H 5.35 N 4.28

2-(4-Methoxyphenyl)-1-methyl-5-phenyl-3-pyrrolecarbaldehyde (**4g**): From **1a** (1.03 g, 3.6 mmol) and **2g** (2.0 g, 7.0 mmol) in acetonitrile (20 ml) and elaboration according to method b). From diisopropyl ether 0.55 g (52%), m. p. 99–100°C. – IR (Nujol): 1654 cm^{-1} (C=O). – ^{1}H NMR ($CDCl_3$): δ = 3.42 (s, 3H, NCH_3); 3.92 (s, 3H, OCH_3); 6.74 (s, 1H, 4-H); 6.8–7.6 (m, 9 aromat. H); 9.55 (s, 1H, CHO).

$C_{19}H_{17}NO_2$ (291.3) Calcd. C 78.32 H 5.88 N 4.80 Found C 78.04 H 5.90 N 4.60

1,5-Dimethyl-2-phenyl-3-pyrrolecarbaldehyde (**4h**): From 2.02 g (7.0 mmol) of **1b** and 3.0 g (14 mmol) of **2h** in CH_2Cl_2 (50 ml). Elaboration according to method b). From cyclohexane 1.1 g (78%), m.p. 85–86°C. – IR (Nujol): 1650 cm^{-1} (C=O). – ^{1}H NMR ($CDCl_3$): δ = 2.30 (s, 3H, 5-CH_3); 3.41 (s, 3H, NCH_3); 6.42 (s, 1H, 4-H); 7.2–7.65 (m, 5 aromat. H); 9.42 (s, 1H, CHO).

$C_{13}H_{13}NO$ (199.3) Calcd. C 78.36 H 6.57 N 7.03 Found C 78.10 H 6.33 N 7.18

1,2-Dimethyl-5-phenyl-3-pyrrolecarbaldehyde (**4i**) *and 1,2-Dimethyl-3-[[(4-nitrophenyl)-imino]methyl]-5-phenylpyrrole* (**3b**): From **1b** (2.1 g, 7.3 mmol) and **2i** (3.0 g, 14.5 mmol) in CH_2Cl_2 (50 ml) and elaboration according to method a).

3b: From methanol 0.52 g (23%), m.p. 147–148°C. – IR (Nujol): 1605 cm^{-1} (C=N). – ^1H NMR ($CDCl_3$): δ = 2.58 (s, 3H, 2-CH_3); 3.59 (s, 3H, NCH_3); 6.67 (s, 1H, CH=); 7.1–7.5 (m, 9 aromat. H).

$C_{19}H_{17}N_3O_2$ (319.3) Calcd. C 71.45 H 5.36 N 13.15 Found C 71.16 H 5.25 N 12.89

4i: From cyclohexane 0.63 g (45%), m.p. 94°C. – IR (Nujol): 1650 cm^{-1} (C=O). – ^1H NMR ($CDCl_3$): δ = 2.62 (s, 3H, 2-CH_3); 3.56 (s, 3H, NCH_3); 6.56 (s, 1H, 4-H); 7.2–7.5 (m, 5 aromat. H); 9.88 (s, 1H, CHO).

$C_{13}H_{13}NO$ (199.3) Calcd. C 78.36 H 6.57 N 7.03 Found C 78.30 H 6.71 N 6.93

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[1] Part XXV: *N. Almirante, M. Ballabio, G. Bianchetti, A. Cambiaghi,* and *D. Pocar,* J. Chem. Res. 1985, submitted.
[2] *D. D'Oria, D. Pocar, L. M. Rossi,* and *P. Trimarco,* J. Chem. Res. S **1980**, 242.
[3] *D. Pocar, A. Regola, L. M. Rossi,* and *P. Trimarco,* Gazz. Chim. Ital. **111**, 325 (1981).
[4] *P. Dalla Croce, C. La Rosa,* and *D. Pocar,* J. Chem. Res. S **1983**, 296.
[5] *R. Destro, E. Erba, L. Forti, D. Pocar,* and *D. Scarcella,* Liebigs Ann. Chem. **1985**, 1377.
[6] *M. L. Gelmi, D. Pocar, P. Trimarco, M. Valsecchi, R. Destro,* and *M. Ballabio,* Tetrahedron **40**, 4025 (1984).
[7] *H. O. Bayer, R. Huisgen, R. Knorr,* and *F. C. Schaefer,* Chem. Ber. **103**, 2581 (1970).
[8] *R. Huisgen, H. Gotthardt, H. O. Bayer,* and *F. C. Schaefer,* Chem. Ber. **103**, 2611 (1970).
[9] *H. Gotthardt* and *R. Huisgen,* Chem. Ber. **103**, 2625 (1970).
[10] *R. Huisgen, E. Funke, H. Gotthardt,* and *H. L. Panke,* Chem. Ber. **104**, 1532 (1971).
[11] *R. Knorr, R. Huisgen,* and *G. K. Staudinger,* Chem. Ber. **103**, 2639 (1970).
[12] *E. Funke, R. Huisgen,* and *F. C. Schaefer,* Chem. Ber. **104**, 1550 (1971).
[13] *E. Brunn, E. Funke, H. Gotthardt,* and *R. Huisgen,* Chem. Ber. **104**, 1562 (1971).
[14] *D. J. Chadwick,* Pyrroles and their Benzo Derivatives and Structure, in Comprehensive Heterocyclic Chemistry, *A. R. Katritzky* and *C. W. Rees,* ed., p. 165, Pergamon Press, Oxford 1984.
[15] Ref.[14], p. 180.
[16] *M. Besana, P. Dalla Croce, M. L. Gelmi,* and *C. La Rosa,* in preparation.
[17] *P. Dalla Croce, D. Pocar, R. Stradi,* and *P. Trimarco,* J. Chem. Soc., Perkin Trans. 1 **1980**, 141.
[18] *R. E. Steiger,* Org. Synth., Coll. Vol. III, 84 (1955).
[19] *A. Larizza, G. Littieri,* and *R. Viterbo,* J. Med. Chem. **13**, 1019 (1970).

[176/85]