Thermal Ring Transformation of 5-Aryl-2-carbazoyl-1,2,3,4-tetrazole Derivatives

René Milcent* and Géo Barbier

Laboratoire de Chimie Organique Médicale, Université Paris 7, Faculté de Médecine Xavier Bichat,
16, rue Henri Huchard,
75018 Paris, France

Received April 20, 1987

Unstable 5-aryl-2-(3-benzylidene-2-phenylcarbazoyl)-1,2,3,4-tetrazoles **8** have been prepared. By thermal ring transformation, they gave 5-aryl-2-(2-benzylidene-1-phenylhydrazino)-1,3,4-oxadiazoles **9**. Hydrazinolysis of **9** afforded 5-aryl-2-(1-phenylhydrazino)-1,3,4-oxadiazoles **10**. Elimination of a molecule of benzonitrile from **9** on heating converted them into 2-anilino-5-aryl-1,3,4-oxadiazoles **11**.

J. Heterocyclic Chem., **24**, 1233 (1987).

The thermal ring transformation of 2-carbamoyl-1,2,3,4-tetrazoles **1** or 2-thiocarbamoyl-1,2,3,4-tetrazoles **2** into the corresponding derivatives of 2-amino-1,3,4-oxadiazoles, **3** or 2-amino-1,3,4-thiadiazole, **4** have been reported [1-3]. On the other hand, no work has been done on the thermal rearrangement of 2-carbazoyl-1,2,3,4-tetrazole derivatives **5**.

With the aim to contribute to this study and to prepare new 2-hydrazino-1,3,4-oxadiazoles for industrial purposes, sodium salts of 5-aryl-1,2,3,4-tetrazoles **6** were treated with benzaldehyde 2-chloroformyl-2-phenylhydrazone **7** in dry dimethylformamide at 0°. The resulting 5-aryl-2-(3-benzylidene-2-phenylcarbazoyl)-1,2,3,4-tetrazoles **8** were unstable oils which were transformed into 5-aryl-2-(2-benzylidene-1-phenylhydrazino)-1,3,4-oxadiazoles **9** on refluxing in toluene.

Compounds **9** were formed in one step when the reaction of the chloroformylhydrazone **7** with aryl tetrazoles **6** was carried out with the presence of sodium bicarbonate

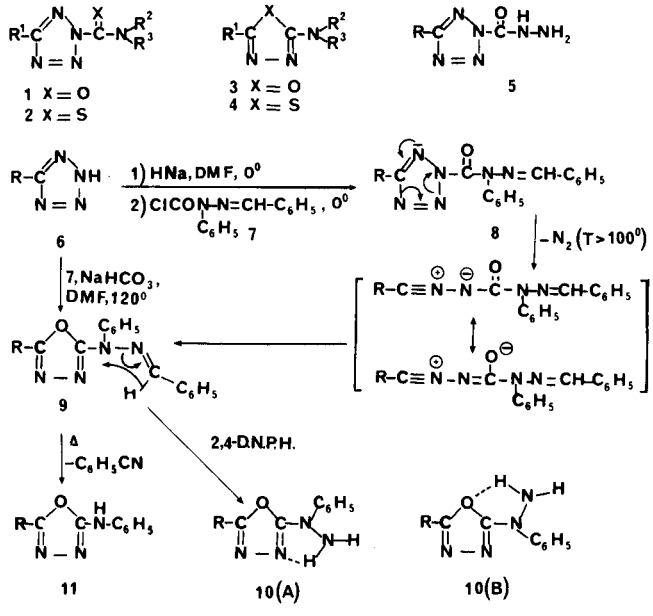

Table I

Compounds **9**, **10** and **11**

No.	R	Yield % [a]	Mp °C	Formula	Analyses Calcd./(Found) C	H	N	IR, ν cm^{-1}	^{1}H NMR [b] δ ppm
9a	C_6H_5	72	158-159 [c]	$C_{21}H_{16}N_4O$	74.1 (74.1)	4.7 (4.8)	16.5 (16.7)	1605, 1575, 1550, 1485	7.2-8.2 (m)
9b	4-CH_3O-C_6H_4	71	149-150 [c]	$C_{22}H_{18}N_4O_2$	71.3 (71.4)	4.9 (4.9)	15.1 (15.3)	1595, 1575, 1550, 1490	3.85 (s, 3H), 7.1-8.1 (m, 15H)
9c	4-Cl-C_6H_4	75	136-137 [c]	$C_{21}H_{15}ClN_4O$	67.3 (67.2)	4.0 (4.0)	15.0 (14.9)	1590, 1560, 1540, 1480	7.3-8.1 (m)
10a	C_6H_5	22	131 [c]	$C_{14}H_{12}N_4O$	66.7 (66.6)	4.8 (4.8)	22.2 (22.1)	3330, 3280, 3190, 1640, 1600	5.75 (sl, 2H), 7.1-8.2 (m, 10H)
10b	4-CH_3O-C_6H_4	40	147-148 [d]	$C_{15}H_{14}N_4O_2$	63.8 (63.7)	5.0 (4.9)	19.9 (19.8)	3340, 3270, 3190, 1595, 1570	3.9 (s, 3H), 5.7 (sl, 2H), 7.1-8 (m, 9H)
10c	4-Cl-C_6H_4	26	165-166 [d]	$C_{14}H_{11}ClN_4O$	58.6 (58.6)	3.9 (3.9)	19.5 (19.6)	3320, 3290, 3180, 1640, 1590	5.8 (s, 2H), 7.1-8.1 (m, 9H)
11a	C_6H_5	91	210 [c,e]	$C_{14}H_{11}N_3O$				3265, 1600, 1575	7-8.1 (m, 10H), 10.7 (s, 1H)
11b	4-CH_3O-C_6H_4	85	198-199 [c,f]	$C_{15}H_{13}N_3O_2$				3260, 1615, 1580	3.95 (s, 3H), 7-8 (m, 9H), 10.6 (s, 1H)
11c	4-Cl-C_6H_4	92	253-255 [c,g]	$C_{14}H_{10}ClN_3O$				3265, 1620, 1600, 1590, 1570	7-8 (m, 9H), 10.7 (s, 1H)

[a] Non optimized yields. [b] All compounds were measured in DMSO-d_6. [c] Ethanol. [d] 1-Propanol. [e] Lit [6] mp 212°. [f] Lit [6] mp 199°. [g] Lig [6] mp 249°.

in dry dimethylformamide for 30 minutes at 120°.

By analogy with the mechanism proposed by Huisgen *et al* for the thermal transformation of compounds **1** and **2** [1], the transformation of compounds **8** to **9** requires the formation of a dipole intermediate followed by cyclization.

Analogous thiocarbazoyl derivatives of **8** could not be prepared in the same way because the benzaldehyde 2-chlorothioformyl-2-phenylhydrazone was not obtained by reaction of the benzaldehyde phenylhydrazone with thiophosgen.

The reaction of **9** with 2,4-dinitrophenylhydrazine in refluxing ethanol for 3 hours yielded new 5-aryl-2-(1-phenylhydrazino)-1,3,4-oxadiazoles **10**.

Heating of **9** in refluxing dimethylformamide for one hour or at dryness above 200° for some minutes, resulted in a formation of the corresponding 2-anilino-5-aryl-1,3,4-oxadiazoles **11** with elimination of a molecule of benzonitrile.

This last reaction has some similarity with the thermal reaction of quaternary hydrazonium salts of benzaldehyde which are decomposed at 240-250° to form benzonitrile and quaternary ammonium salts [4].

We propose a 4-centered cyclic process for this new reaction as in many pyrolytic β-eliminations [5].

Assignment for the structures of the compounds **9**, **10** and **11** (Table I) was provided by elemental analysis and ir and ^{1}H-nmr spectra. Compounds **10** show three N-H absorption bands assignable to their possible structures **A** and **B** with an intramolecular hydrogen bonded NH group. By reaction of **10** with benzaldehyde, compounds **9** were regenerated. Products **11** were found identical with authentic samples [6].

EXPERIMENTAL

Melting points (uncorrected) were taken with a Buchi oil heated apparatus. The ir spectra were recorded on a Perkin-Elmer 1310 spectrophotometer as potassium bromide disks. The ^{1}H-nmr spectra were obtained in DMSO-d_6 on a Brucker WP 80 spectrometer and are reported as δ values (ppm) relative to tetramethylsilane as an internal standard.

5-Aryl-2-(3-benzylidene-2-phenylcarbazoyl)-1,2,3,4-tetrazoles **8**.

Sodium hydride (50% in oil) (0.48 g, 10 mmoles) was added to a stirred solution of 10 mmoles of **6** in 40 ml of dry dimethylformamide at 0°. When hydrogen gas evolution ceased, a solution of 2.58 g (10 mmoles) of chloroformylhydrazone **7** in 20 ml of dry dichloromethane was slowly added at 0°. The reaction mixture was stirred for 30 minutes at 0° and poured onto 200 ml of ice-water. Compounds **8** were extracted with ether and the organic layer was separated, washed several times with water and dried over anhydrous magnesium sulfate. After removal of the ether, each compound **8** was obtained as an impure, unstable and dense oil which decomposed by chromatography.

5-Aryl-2-(2-benylidene-1-phenylhydrazino)-1,3,4-oxadiazoles **9**. Method A.

To a stirred solution of 10 mmoles of **6** in 40 ml of dry dimethylformamide were added 2.58 g (10 mmoles) of **7** and 1 g (12 mmoles) of sodium bicarbonate. The reaction mixture was stirred for 30 minutes at 120° and filtered. After removal of the solvent, the crude residue was dissolved in 100 ml of hot ethanol. The solution was filtered and the solvent evaporated. Compounds **9** were recristallized from ethanol.

Method B.

A solution of 10 mmoles of **8** in 50 ml of toluene was refluxed for one hour. After removal of the solvent, the resulting residue was recristallized from ethanol.

5-Aryl-2-(1-phenylhydrazino)-1,3,4-oxadiazoles **10**.

To a solution of 10 mmoles of **9** in 50 ml of ethanol, was added 1.98 g (10 mmoles) of 2,4-dinitrophenylhydrazine. The mixture was stirred at reflux for 3 hours and filtered. After removal of the solvent, the compounds **10** were purified by column chromatography on silica gel 60 0.05-0.2 mm (Macherey-Nagel) using benzene:ethyl acetate (19:1) as the eluent and recrystallized from ethanol or 1-propanol.

2-Anilino-5-aryl-1,3,4-oxadiazoles **11**.

A solution of 10 mmoles of **9** in 40 ml of dimethylformamide was refluxed for one hour. After removal of the solvent, compounds **11** were recristallized from ethanol.

REFERENCES AND NOTES

[1] R. Huisgen, H. J. Sturm and M. Seidel, *Chem. Ber.*, **94**, 1555 (1961).

[2] N. A. Dahle, U. S. Patent, 3,790,588 (1974); *Chem. Abstr.*, **80**, 82993 (1974).

[3] N. A. Dahle and W. C. Doyle, Jr., U. S. Patent, 3,808,223 (1974); *Chem. Abstr.*, **81**, 13524 (1974).

[4] R. B. Hanson, F. Foley, Jr., E. I. Anderson and M. H. Aldbridge, *J. Org. Chem.*, **35**, 1753 (1970).

[5] R. F. C. Brown, "Pyrolytic Methods in Organic Chemistry", Vol **41**, H. Wasserman, ed, Academic Press, 1980, p 73.

[6] R. Madhavan and V. R. Srinivasan, *Indian J. Chem.*, **7**, 760 (1969).