Pergamon

Tetrahedron Letters 41 (2000) 771–773

TETRAHEDRON LETTERS

An unknown route of cyclocondensation of *peri*-acetylenylquinones with hydrazine

Mark S. Shvartsberg * and Irena D. Ivanchikova

Institute of Chemical Kinetics and Combustion, Siberian Branch of Russian Academy of Sciences, Novosibirsk 630090, Russia

Received 21 October 1999; accepted 17 November 1999

Abstract

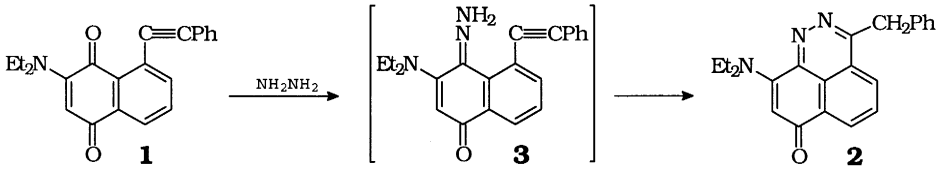
Cyclocondensation of 3-diethylamino-5-phenylethynyl-l,4-naphthoquinone with NH_2NH_2 resulting in the closure of a pyridazine ring is reported. This hydrazine condensation was unknown for *peri*-acetylenic derivatives of polycyclic quinones. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: polycyclic *peri*-acetylenylquinones; hydrazine; cyclocondensation.

Heterocyclization of acetylenic quinone derivatives provides a promising synthesis of biologically active condensed heterocycles.[1] Formerly, we reported that 1-acetylenyl-9,10-anthraquinones add NH_2NH_2 to the triple bond and cyclize to give heterocyclic anthrones-7*H*-dibenzo[*de,h*]quinolin-7-ones and 4*H*-anthra[9,1-*cd*]diazepin-8-ones.[1c,2] The latter, under the reaction conditions, undergo a reductive contraction of the seven-membered heterocycle and are transformed into the corresponding pyridoanthrones.

Continuing our study, we have found that *peri*-acetylenic naphthoquinones react with NH_2NH_2 in a different way, the reaction being sensitive to the structure of the substrate. In this communication we describe briefly a hydrazine cyclocondensation in this quinone series that is unknown for *peri*-acetylenylanthraquinones.

3-Diethylamino-5-phenylethynyl-1,4-naphthoquinone **1**[3] in contrast to 1-acetylenyl-9,10-anthraquinones condenses with NH_2NH_2 (pyridine, 115°C, 8 h) to close a six-membered pyridazine ring and gives 3-benzyl-9-diethylaminobenzo[*de*]cinnolin-7-one **2**[4] in 60% yield (Scheme 1).



Scheme 1.

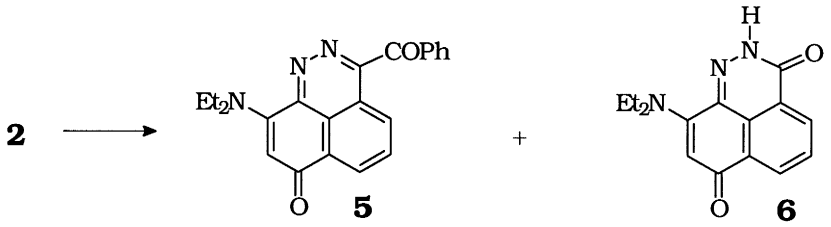
* Corresponding author.

PII: S0040-4039(99)02151-6

N-Nucleophiles, on adding intermolecularly to acetylenic quinones, form an N–C bond with the β-carbon atom of the acetylenic substituent.[1e,3] The pyridazine ring of condensation product **2** is built, however, with participation of the α-C of this substituent. Therefore, the cyclocondensation of **1** includes, as its initial stage, nucleophilic attack by NH_2NH_2 on the carbonyl in position 4 rather than on the triple bond and proceeds via the hydrazone **3**.

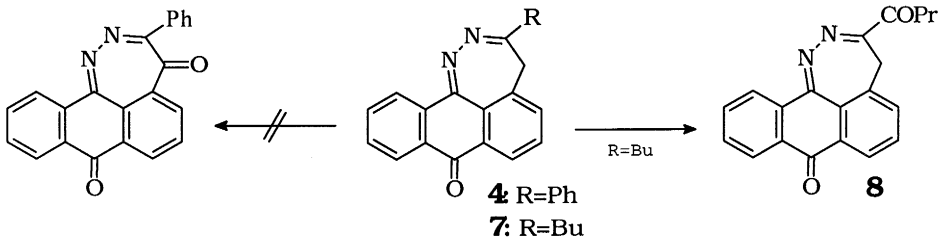
In the ^{1}H NMR spectrum of **2** there is a singlet at δ 4.81 ppm for the methylene protons whereas in the spectrum of 4*H*-3-phenylanthra[9,1-*cd*]diazepin-8-one **4**, prepared analogously from 1-phenylethynyl-9,10-anthraquinone,[1c,2b] the methylene protons of the non-planar seven-membered ring appear as two doublets at δ 3.13 and 4.43 ppm with geminal coupling (J=13.3 Hz). In this connection, one might consider that **2** contains either a benzyl substituted six-membered pyridazine ring or a seven-membered 3-phenyldiazepine ring but a much more flexible one than in anthrone **4**.

To confirm the presence of the six-membered heterocycle in **2**, this compound was oxidized using activated MnO_2 ($CHCl_3$:acetone, 1:1, 4 h at 20°C and 1 h at 60°C). The reaction afforded 3-benzoyl-9-diethylaminobenzo[*de*]cinnolin-7-one **5**[4] in 66% yield together with 9-diethylaminobenzo[*de*]cinnoline-3,7-dione **6**[4] (8%) (Scheme 2). An additive downfield shift of the *ortho*-H of the phenyl group in the ^{1}H NMR spectrum of **5** testifies to the direct linkage between the phenyl and the carbonyl group.



Scheme 2.

It is noteworthy that phenyldiazepinoanthrone **4** is not oxidized under the same conditions and its butyl analog **7** gives the 3-butyryl derivative **8**[5] in 89% yield (Scheme 3).

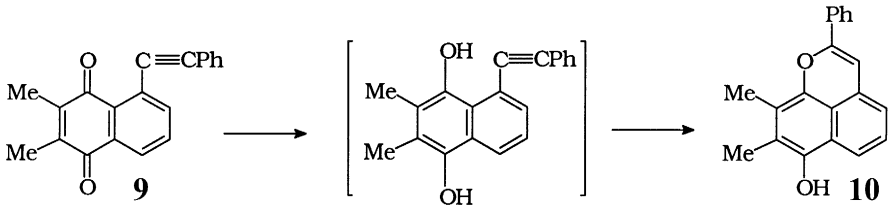


Scheme 3.

The structures of benzocinnolinones **2** and **5** are additionally confirmed by their mass spectra which contain intensive peaks corresponding to ions $PhCH_2$ (91), [M−$PhCH_2$] (252) and PhCO (105), [M−PhCO] (252). This proves the presence in **2** and **5** of benzyl and benzoyl side chains, respectively. For comparison, the spectrum of phenyldiazepinoanthrone **4** does not contain peaks of ions $PhCH_2$ and [M−$PhCH_2$]. The most intensive peak in it belongs to the ion [M−$PhCCH_2$] (219).

A strong influence of the naphthoquinone structure on the reaction with NH_2NH_2 can be illustrated using 2,3-dimethyl-5-phenylethynyl-1,4-naphthoquinone **9** (Scheme 4).[6] Quinone **9**, unlike **1**, does not condense with NH_2NH_2, but undergoes a reductive cyclization probably to substituted naphtho[1,8-*bc*]pyran **10**.[6]

In conclusion, 3-diethylamino-5-phenylethynyl-1,4-naphthoquinone **1**, in contrast to 1-phenylethynyl- and relative 1-acetylenyl-9,10-anthraquinones, condenses with NH_2NH_2 to form a pyridazine



Scheme 4.

ring, presumably via the quinone monohydrazone **3**. The reaction offers a way of synthesizing some derivatives of benzo[*de*]cinnolin-7-one.

Acknowledgements

Financial support from the Russian Foundation for Basic Research through grant no. 98-03-32945a is gratefully acknowledged.

References

1. (a) Mzhel'skaya, M. A.; Moroz, A. A.; Shvartsberg, M. S. *Izv. Akad. Nauk. SSSR, Ser. Khim.* **1991**, 1656–1659. (b) Shvartsberg, M. S.; Piskunov, A. V.; Mzhel'skaya, M. A.; Moroz, A. A. *Izv. Akad. Nauk., Ser. Khim.* **1993**, 1423–1428. (c) Shvartsberg, M. S.; Ivanchikova, I. D.; Vasilevsky, S. F. *Tetrahedron Lett.* **1994**, *35*, 2077–2080. (d) Shvartsberg, M. S.; Ivanchikova, I. D.; Fedenok, L. G. *Tetrahedron Lett.* **1994**, *35*, 6749–6752. (e) Piskunov, A. V.; Shvartsberg, M. S. *Mendeleev Commun.* **1995**, 155–156. (f) Shvartsberg, M. S.; Barabanov, I. I.; Fedenok, L. G. *Mendeleev Commun.* **1997**, 98–99.
2. (a) Ivanchikova, I. D.; Myasnikova, R. N.; Shvartsberg, M. S. *Izv. Akad. Nauk, Ser. Khim.* **1998**, 2031–2035. (b) Shvartsberg, M. S.; Ivanchikova, I. D.; Vasilevsky, S. F. *Izv. Akad. Nauk, Ser. Khim.* **1998**, 2027–2030.
3. Shvartsberg, M. S.; Moroz, A. A.; Ivashkina, N. V.; Cherepanov, S. B. *Izv. Akad. Nauk. SSSR, Ser. Khim.* **1986**, 2485–2491.
4. All compounds gave satisfactory analytical and spectroscopic data. Compound **2**: mp 152–153°C (C_6H_6–hexane); δ_H (250 MHz, $CDCl_3$) 1.43 (t, J=6.9 Hz, 6H, CH_3), 3.92 (q, J=6.9 Hz, 4H, CH_2N), 4.81 (s, 2H, CH_2), 6.09 (s, 1H, H^8), 7.15–7.40 (m, 5H, Ph), 7.85–7.90 (m, 1H, H^5), 8.20 (d, J=7.9 Hz, 1H, $H^{4(6)}$), 8.55 (d, J=7.0 Hz, 1H, $H^{6(4)}$). Compound **5**: mp 146–148°C (C_6H_6–hexane); 1.43 (t, J=7.0 Hz, 6H, CH_3), 3.92 (q, J=7.0 Hz, 4H, CH_2N), 6.17 (s, 1H, H^8), 7.45–7.55 (m, 2H, *m*-H Ph), 7.60–7.75 (m, 1H, *p*-H Ph), 7.95–8.10 (m, 3H, H^5, *o*-H Ph), 8.27 (d, J=8.5 Hz, 1H, $H^{4(6)}$), 8.66 (d, J=7.0 Hz, 1H, $H^{6(4)}$). Compound **6**: mp 253–254°C (PhMe–hexane); 1.32 (t, J=7.0 Hz, 6H, CH_3), 3.69 (q, J=7.0 Hz, 4H, CH_2N), 5.98 (s, 1H, H^8), 7.88 (t, J=7.0 Hz, 1H, H^5), 8.50 (d, J=8.0 Hz, 1H, $H^{4(6)}$), 8.53 (d, J=8.0 Hz, 1H, $H^{6(4)}$), 11.32 (br.s, 1H, NH).
5. Compound **8**: mp 175–176°C (C_6H_6–hexane); δ_H 0.90 (t, J=7.5 Hz, 3H, CH_3), 1.55–1.75 (m, 2H, CH_2), 2.67 (d, J=12.5 Hz, 1H, $H_a{}^4$), 2.75–3.10 (m, 2H, CH_2CO), 4.57 (d, J=12.5 Hz, 1H, $H_b{}^4$), 7.55–7.85 (m, 4H, $H^{5,6,10,11}$), 8.15–8.40 (m, 3H, $H^{7,9,12}$).
6. Compound **9**: mp 140–142°C (C_6H_6–hexane); δ_H 2.18 (s, 3H, CH_3), 2.22 (s, 3H, CH_3), 7.30–7.45 (m, 3H, *p*-, *m*-H Ph), 7.55–7.75 (m, 3H, H^7, *o*-H Ph), 7.87 (dd, $J_{6(8),7}$=7.5 Hz, $J_{6(8),8(6)}$=1.5 Hz, 1H, $H^{6(8)}$), 8.10 (dd, $J_{8(6),7}$=7.5 Hz, $J_{8(6),6(8)}$=1.5 Hz, 1H, $H^{8(6)}$). Compound **10**: mp 310–312°C (decomp.); 1.61 (br.s, 1H, OH), 2.33 (s, 3H, CH_3), 2.47 (s, 3H, CH_3), 6.37 (s, 1H, H^3), 7.35–7.55 (m, 5H, $H^{4,5}$, *p*-, *m*-H Ph), 7.67 (dd, $J_{6,5}$=7.1 Hz, $J_{6,4}$=1.8 Hz, 1H, H^6), 7.85 (d, J=7.1 Hz, 2H, *o*-H Ph).