SYNTHESIS OF 2-SUBSTITUTED NAPHTHO[2,3-f]ISOQUINOLINE-7,12-DIONE N-OXIDES

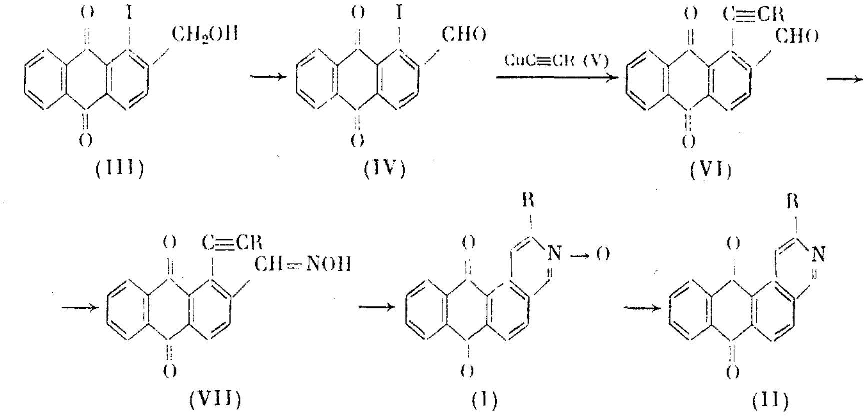
I. D. Ivanchikova, A. A. Moroz,
and M. S. Shvartsberg

UDC 66.095.252:547.673:542.91:
547.833.7+547.836.3

1-Acetylenyl-2-formylanthraquinone oximes cyclize upon heating in an ethanol–water solution of K_2CO_3 to give 2-substituted naphtho[2,3-f]isoquinoline-7,12-dione N-oxides.

In previous work [1], we found that oximes of vicinal acetylenic derivatives of 3-formyl-1-methylindole readily cyclize with closure of a pyridine N-oxide ring. A similar cyclization was carried out by Yamanaka and coworkers [2, 3] for benzene and pyridine compounds.

In a continuation of a study of methods to obtain condensed heterocyclic structures starting with acetylenic synthones [1, 4, 5], we have employed this reaction for the synthesis of naphtho[2,3-f]isoquinoline-7,12-dione N-oxides (I) and isoquinoline-7,12-diones (II) from the corresponding anthraquinones.



R = Bu(a), Ph(b), CH$_2$OPh(c).

Carbinol (III), obtained from 1-amino-2-hydroxymethylanthraquinone [6] by diazotization and subsequent replacement of the diazo group by I, was oxidized by activated MnO_2 virtually quantitatively to give iodoaldehyde (IV), which was then condensed with cuprous acetylenides (V) in pyridine at 45°C. The condensation was complete in 15-20 min and led to acetylenic derivatives (VI) in 71-88% yield (Table 1). Aldoximes (VII) were obtained by brief heating of (VI) with NH_2OH in aqueous ethanol. Under analogous conditions but in the presence of potassium carbonate, oximes (VII) undergo cyclization to give N-oxides (I). In this case, (VIIb) requires 1 h for completion, while (VIIa) and (VIIc) require only 10-15 min. The yields of oxides (I) ranged from 71 to 98% (Table 2). Oxides (I) were reduced with PCl_3 to give anthraquinonepyridines (II) in yields greater than 90%. The analytical and spectral data were in complete accord with the structures proposed for these products (Tables 1 and 2).

EXPERIMENTAL

The PMR spectra were taken on a Jeol FX90Q spectrometer in $CDCl_3$, while the IR spectra were taken on a UR-20 spectrometer. Thin-layer chromatographic monitoring of the reaction

---

Institute of Chemical Kinetics and Combustion, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk. Novosibirsk State University. Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 6, pp. 1447-1450, June, 1991. Original article submitted August 2, 1990.

0568-5230/91/4006-1286$12.50

TABLE 1. Synthesis of 1-Acetylenyl-2-formylanthraquinones (VI) and Their Oximes (VII)

Compound	Yield, %	Mp, °C (from benzene-hexane)	Found/Calculated, %			Empirical formula	PMR spectrum δ, ppm	IR spectrum ν, cm^{-1}
			C	H	N			
(VIa)	88,6	125–126	79,70/79,73	5,08/5,10	–	$C_{21}H_{16}O_3$	1,00 t (CH_3), 1,40–1,85 m (β- and γ-CH_2), 2,68 t (α-CH_2), 7,7–7,9 m ($H^{6,7}$), 8,15–8,40 m ($H^{3-5,8}$), 10,80 (CHO)	2220 ($C\equiv C$); 1685, 1695 (C=O)
(VIb)	74,0	233–234	82,28/82,30	3,69/3,60	–	$C_{23}H_{12}O_3$	7,35–7,50 m (3H Ph), 7,7–7,9 m ($H^{6,7}$, 2H Ph), 8,20–8,45 m ($H^{3-5,8}$), 10,94 (CHO)	2210 ($C\equiv C$); 1680, 1700 (C=O)
(VIc)	71,4	156–157,5	78,79/78,68	3,87/3,85	–	$C_{24}H_{14}O_4$	5,16 (CH_2), 7,00–7,45 m (Ph), 7,75–7,90 m ($H^{6,7}$), 8,15–8,45 m ($H^{3-5,8}$), 10,56 (CHO)	2230 ($C\equiv C$); 1685, sh 1695 (C=O)
(VIIa)	88,0	175–176	76,20/76,12	5,12/5,17	4,14/4,23	$C_{21}H_{17}NO_3$	1,01 t (CH_3), 1,50–1,85 m (β- and γ-CH_2), 2,68 t (α-CH_2). 7,65–7,85 m ($H^{6,7}$). 8,20–8,35 m ($H^{3-5,8}$), 8,88 (=CH)	2220 ($C\equiv C$); 3570, 3330 br (OH): 1680 (C=O)
(VIIb)	85,7	242–243	78,61/78,62	3,77/3,73	3,81/3,99	$C_{23}H_{13}NO_3$	7,45–7,80 m (Ph), 7,85–8,00 ($H^{6,7}$), 8,1–8,4 m ($H^{3-5,8}$), 8,77 (=CH), 12,16 (OH)	(Vaseline mull) 2215 ($C\equiv C$); 3410 br (OH); 1665, 1680 (C=O)
(VIIc)	75,0	195–196	75,69/75,58	4,18/3,96	3,60/3,67	$C_{24}H_{15}NO_4$	5,15 (CH_2), 7,1–7,5 m (Ph), 7,7–7,9 m ($H^{6,7}$), 8,1–8,4 ($H^{3-5,8}$), 8,72 (=CH)	(Vaseline mull) 3320 br (OH); 1680 (C=O)

TABLE 2. 2-Substituted Naphtho[2,3-f]isoquinoline-7,12-diones (II) and Their N-Oxides (I)

Compound	Yield, %	Mp, °C	Found/Calculated, %			Empirical formula	PMR spectrum, δ, ppm
			C	H	N		
(Ia)	97,7	214–215 (toluene)	76,20/76,12	5.16/5,16	4.22/4,23	$C_{21}H_{17}NO_3$	1,02 t (CH_3), 1,4–1,9 m (β- and γ-CH_2), 3,12 t (α-CH_2), 7,70–8,05 m ($H^{5(6),9,10}$), 8,15–8,40 m ($H^{8,11}$), 8,45 d ($H^{6(5)}$), 8,83–9.58 ($H^{1,4}$)
(Ib)	70,8	284–285.5 (toluene)	78,37/78,62	3,55/3,73	3,87/3.99	$C_{23}H_{13}NO$	
(Ic)	93,9	266–267,5 (toluene)	75,17/75,58	3,79/3,96	3,52/3,67	$C_{24}H_{15}NO_4$	5.44 (CH_2), 7,0–7,5 m (Ph), 7,75–8,15 m ($H^{5(6),9,10}$), 8,15–8,60 m ($H^{6(5),8,11}$), 8,87, 9,98 ($H^{1,4}$)
(IIa)	93,8	118–119 (benzene–hexane)	79,96/79,98	5,29/5,43	4,27/4.44	$C_{21}H_{17}NO_2$	1.00 t $(CH_3)_2$, 1,2–2,0 m (β- and γ-CH_2), 3,07 t (α-CH_2), 7,70–7,95 m ($H^{9,10}$), 8,15–8,50 m ($H^{5,6,8,11}$), 9,30, 9,35 ($H^{1,4}$)
(IIb)	~100	263–264 (benzene–hexane)	82,30/82,37	4,01/3.91	3,94/4,18	$C_{23}H_{13}NO_2$	7,35–7,60 m (3H Ph), 7.7–7.9 m ($H^{9,10}$), 8,15–8.50 m ($H^{5,6,8,11}$, 2H Ph), 9,43, 10,03 ($H^{1,4}$)
(IIc)	94,3	206–207 (benzene–hexane)	78,82/78,89	4,11/4,14	3,64/3,83	$C_{24}H_{15}NO_3$	5,33 (CH_2), 6,90–7,45 m (Ph), 7,65–7,95 m ($H^{9,10}$), 8,15–8,60 m ($H^{5,6,8,11}$), 9,35, 9,68 ($H^{1,4}$)

course was carried out on Silufol plates using chloroform and 6:1 chloroform–ether as the eluents.

1-Iodo-2-formylanthraquinone (IV). A sample of 30 g activated MnO_2 was added to a solution of 4.2 g (III) [mp 214.5-215.5°C (from benzene). Found, %: C 49.51; H 2.56; I 34.90. $C_{15}H_9IO_3$. Calculated, %: C 49.48; H 2.49; I 34.85] in a mixture of 300 ml acetone and 300 ml $CHCl_3$ at 50°C and stirred for 40 min. The mixture was filtered and the precipitate was thoroughly washed with chloroform. Removal of the solvent in vacuum gave 4.0 g (96%) (IV), mp 199-200°C (from benzene–hexane) [7]. PMR spectrum (δ, ppm): 7.7-8.0 m ($H^{6,7}$), 8.09 d, 8.40 d ($H^{3,4}$), 8.1-8.4 m ($H^{5,8}$), 10.51 (CHO).

1-(Hexyn-1-yl)-2-formylanthraquinone (VIa). A mixture of 0.9 g (IV) and 0.6 g (Va) in 90 ml pyridine was stirred for 20 min at 45°C in an argon atmosphere and then diluted with 300 ml chloroform. The mixture was washed with 300 ml of a solution containing one part concentrated hydrochloric acid and three parts water and, then, water and dried over $MgSO_4$. Chromatography on silica gel with benzene eluent gave 0.7 g (VIa) (see Table 1).

Products (VIb) and (VIc) were obtained by analogy (see Table 1).

1-(Hexyn-1-yl)anthraquinon-2-aldoxime (VIIa). A solution of NH_2OH prepared by neutralizing 0.52 g $NH_2OH \cdot HCl$ in 6 ml water with 0.38 g Na_2CO_3 was added to 0.48 g (VIa) in 80 ml ethanol, heated at reflux for 20 min, diluted with 100 ml $CHCl_3$, washed with water and dried over $MgSO_4$. Chromatography on silica gel with benzene eluent gave 0.44 g (VIIa) (see Table 1).

Products (VIIb) and (VIIc) were obtained by analogy (see Table 1).

2-Butylnaphtho[2,3-f]isoquinoline-7,12-dione N-Oxide (Ia). A sample of 0.44 g (VIIa) in 45 ml ethanol was added to 0.4 g K_2CO_3 in 2 ml water, heated at reflux for 15 min, diluted with 200 ml $CHCl_3$, and washed with water. After distilling off chloroform in vacuum, chromatography on silica gel with chloroform eluent gave 0.43 g (Ia) (see Table 2).

Oxides (Ib) and (Ic) were obtained by analogy (see Table 2).

2-Butylnaphtho[2,3-f]isoquinoline-7,12-dione (IIa). A mixture of 0.17 g (Ia) and 0.1 ml PCl_3 in 10 ml dry chloroform was heated at reflux for 20 min, poured into water, and neutralized with aqueous $NaHCO_3$. Product (IIa) was extracted with $CHCl_3$ and purified by chromatography on silica gel with chloroform eluent. The yield of (IIa) was 0.15 g (see Table 2).

Products (Ib) and (Ic) were reduced analogously to give (IIb) and (IIc) (see Table 2).

LITERATURE CITED

1. T. A. Prikhod'ko, S. F. Vasilevskii, and M. S. Shvartsberg, Izv. Akad. Nauk SSSR, Ser. Khim., No. 11, 2602 (1984).
2. T. Sakamoto, Y. Kondo, N. Miura, et al., Heterocycles, 24, 2311 (1986).
3. T. Sakamoto, Y. Kondo, and H. Yamanaka, Heterocycles, 27, 2225 (1988).
4. S. F. Vasilevskii, A. V. Pozdnyakov, and M. S. Shvartsberg, Izv. Akad. Nauk SSSR, Ser. Khim., No. 6, 1367 (1985).
5. M. S. Shvartsberg, A. A. Moroz, A. V. Piskunov, and I. A. Budzinskaya, Izv. Akad. Nauk SSSR, Ser. Khim., No. 11, 2517 (1987).
6. K. Bredereck, L. Banzhaf, and E. Koch, Chem. Ber., 105, 1062 (1972).
7. Beilsteins Handbuch der Organischen Chemie, Vol. 7 (E II) (1948), p. 837.

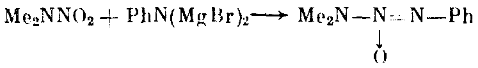
SYNTHESIS OF 1-PHENYL-3,3-DIMETHYLTRIAZENE 2-OXIDE AND THE CORRESPONDING TRIAZENE FROM NITRO COMPOUNDS AND N-MAGNESIUM BROMIDES

É. T. Apasov, B. A. Dzhetigenov, A. V. Kalinin,
and V. A. Tartakovskii

UDC 542.91:547.416:547.551+
546.46'141

The reaction of dimethylnitramine with $Ph{-}N(MgBr)_2$ gives 1-phenyl-3,3-dimethyltriazene 2-oxide, which is the first reported triazene 2-oxide. The reaction of nitrobenzene with $Me_2NNHMgBr$ gives only the corresponding triazene.

Triazene 1-oxides are well-known compounds [1]. However, no information has been available on triazene 2-oxides, in which N^1 is directly bound to a carbon atom. The first representative of this class, 1-phenyl-3,3-dimethyltriazene 2-oxide (III), was obtained according to the following scheme.



$$Me_2NNO_2 + PhN(MgBr)_2 \longrightarrow Me_2N{-}\underset{\substack{\downarrow \\ O}}{N}{=}N{-}Ph \qquad (1)$$

(I) (II) (III)

An attempt to obtain 1-phenyl-3,3-dimethyltriazene 1-oxide, which is an isomer of (III), by the action the magnesium derivative of dimethylhydrazine (IV) on nitrobenzene proved unsuccessful. The reaction product does not contain an N-oxide fragment, apparently as a result of the high reductive capacity of (IV).

$$PhNO_2 + \underset{(IV)}{Me_2NNHMgBr} \longrightarrow PhN{=}N{-}NMe_2 \qquad (2)$$

Reductive condensation with formation of only an azo product was also observed in reaction (3).

N. D. Zelinskii Institute of Organic Chemistry, Academy of Sciences of the USSR, Moscow. Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 6, pp. 1450-1451, June, 1991. Original article submitted September 14, 1990.