

Chemistry of Diazopolycarbonyl Compounds: VII.* Reactions of 3-Diazo-2-oxopropionic Acid Derivatives with Aroylhydrazines

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Abstract—3-Diazo-2-oxopropionic acid esters and amides react with benzoic and salicylic acid hydrazides to afford 2,3-bis(aroylhydrazono)propionic acid esters and amides having an osazone structure.

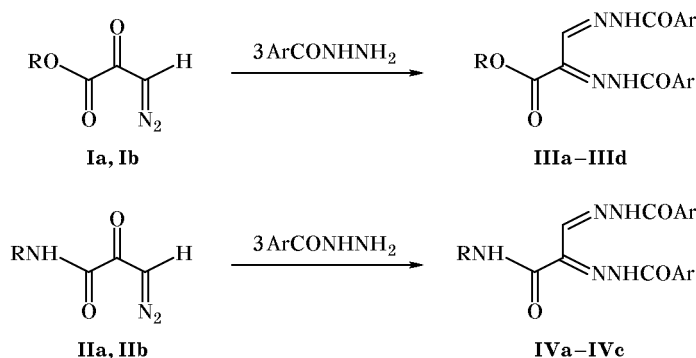
We previously showed [1–3] that the structure of products formed by reactions of alkyl 3-diazo-2-oxopropionates **I** with NH-nucleophiles depends on the nucleophilicity of the reagent. Diazo esters **I** reacted with aliphatic amines and hydrazines to afford diazo amides **II** and diazo hydrazides [2, 3], whereas reactions of diazo esters **I** and diazo amides **II** with phenylhydrazine led to formation of mixtures of products which contained 2,3-bis(phenylhydrazono)propionic acid esters and amides [1].

We have found that 3-diazo-2-oxopropionic acid esters **Ia** and **Ib** and amides **IIa** and **IIb** react with benzohydrazide and salicylic hydrazide only at

elevated temperature and that these reactions give mixtures of products (up to 6 compounds, according to TLC). The corresponding 2,3-bis(aroylhydrazono)propionic acid esters **IIIa–IIIc** and amides **IVa–IVc** were isolated in 22 to 61% yield (Tables 1, 2; Scheme 1).

The spectral parameters of compounds **III** and **IV** suggest that these compounds have osazone structure with a number of intramolecular hydrogen bonds which are responsible for broadening of the carbonyl and NH stretching vibration bands in the IR spectra. In the ¹H NMR spectra, signals of the NH protons are located at δ 12.18–12.45 and 14.25–14.65 ppm.

Scheme 1.



I, R = Et (**a**), Bu (**b**); **II**, R = Bu (**a**), PhCH₂ (**b**); **III**, Ar = Ph, R = Et (**a**), Bu (**b**); Ar = *o*-HOC₆H₄, R = Et (**c**), Bu (**d**);
IV, Ar = Ph, R = PhCH₂ (**a**); Ar = *o*-HOC₆H₄, R = Bu (**b**), PhCH₂ (**c**).

* For communication VI, see [1].

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Table 1. Yields, melting point, and IR and ^1H NMR spectra of compounds **IIIa–IIIc** and **IVa–IVc**

Comp. no.	Yield, %	mp, °C	IR spectrum, ν , cm^{-1}	^1H NMR spectrum, δ , ppm
IIIa	61	227–229	3334, 3305 (NH); 1705 (C=O); 1680 br (CONH)	1.38 t (3H, CH_3), 4.31 q (2H, CH_2), 7.68 m (10H, $2\text{C}_6\text{H}_5$), 8.66 s (1H, CH), 12.45 s (1H, NH), 14.65 s (1H, NH)
IIIb	48	202–204	3325, 3300 (NH); 1700 br (C=O)	0.91 t (3H, CH_3), 1.58 m (4H, 2CH_2), 4.22 t (2H, CH_2), 7.78 m (10H, $2\text{C}_6\text{H}_5$), 8.65 s (1H, CH), 12.52 s (1H, NH), 14.65 s (1H, NH)
IIIc	45	209–211	3410 br, 3266 (NH, OH); 1707 (C=O); 1658 br (CONH)	1.25 t (3H, CH_3), 4.22 q (2H, CH_2), 7.73 m (8H, $2\text{C}_6\text{H}_4$), 8.52 s (1H, CH), 11.31 br.s (2H, 2OH), 12.35 s (1H, NH), 14.25 s (1H, NH)
IIIc	22	155–157	3448, 3240 br (NH, OH); 1702 (C=O); 1640 br (CONH)	0.95 t (3H, CH_3), 1.45 m (4H, 2CH_2), 4.15 t (2H, CH_2), 7.18 m (10H, $2\text{C}_6\text{H}_5$), 8.45 s (1H, CH), 11.18 br.s (2H, 2OH), 12.18 s (1H, NH), 14.25 s (1H, NH)
IVa	47	241–243	3396, 3200 br (NH); 1677 br (C=O)	4.45 d (2H, CH_2), 7.25 s (5H, C_6H_5), 7.60 m (10H, $2\text{C}_6\text{H}_5$), 8.62 s (2H, NHCO, CH), 12.31 s (NH), 14.38 s (NH)
IVb	28	219–221	3430 br, 3200 br (NH, OH); 1662 br, 1645 (C=O)	0.97 t (3H, CH_3), 1.36 sept (2H, CH_2), 1.55 quint (2H, CH_2), 3.28 q (2H, CH_2), 7.35 m (8H, $2\text{C}_6\text{H}_4$), 8.09 s (BuNHCO), 8.72 s (1H, CH), 11.47 s (2H, 2OH), 12.32 s (1H, NH), 14.38 s (1H, NH)
IVc	23	237–238	3445 br, 3230 br (NH, OH); 1658 br (C=O)	4.48 d (2H, CH_2), 7.38 m (13H, $2\text{C}_6\text{H}_4$, C_6H_5), 8.68 s (1H, NH), 8.75 s (1H, CH), 11.40 s (2H, 2OH), 12.35 s (1H, NH), 14.42 s (1H, NH)

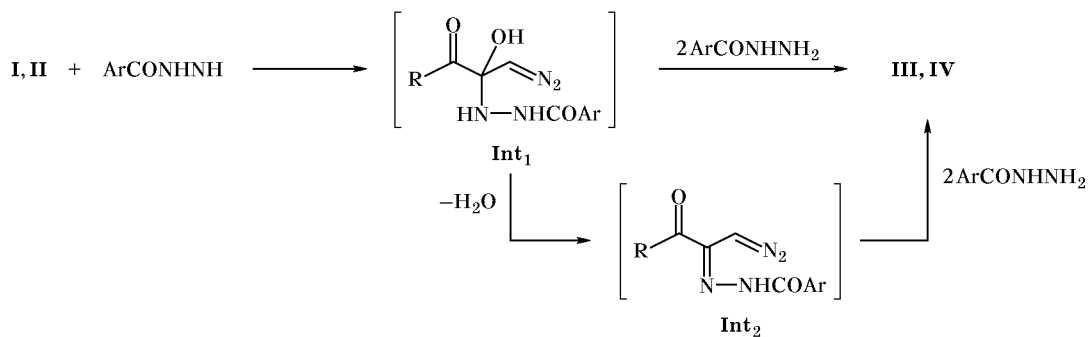
Table 2. Elemental analyses of compounds **IIIa–IIIc** and **IVa–IVc**

Comp. no.	Found, %			Formula	Calculated, %		
	C	H	N		C	H	N
IIIa	62.37	5.12	15.40	$\text{C}_{19}\text{H}_{18}\text{N}_4\text{O}_4$	62.29	4.95	15.29
IIIb	64.09	5.55	14.03	$\text{C}_{21}\text{H}_{22}\text{N}_4\text{O}_4$	63.95	5.62	14.20
IIIc	57.18	4.71	13.88	$\text{C}_{19}\text{H}_{18}\text{N}_4\text{O}_6$	57.29	4.55	14.06
IIIc	59.01	5.35	13.11	$\text{C}_{21}\text{H}_{22}\text{N}_4\text{O}_6$	59.15	5.20	13.14
IVa	67.60	5.08	16.22	$\text{C}_{24}\text{H}_{21}\text{N}_5\text{O}_3$	67.44	4.95	16.38
IVb	59.41	5.30	16.24	$\text{C}_{21}\text{H}_{23}\text{N}_5\text{O}_5$	59.29	5.44	16.46
IVc	62.83	4.77	15.12	$\text{C}_{24}\text{H}_{21}\text{N}_5\text{O}_5$	62.74	4.61	15.24

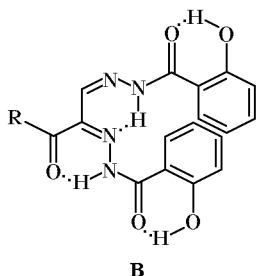
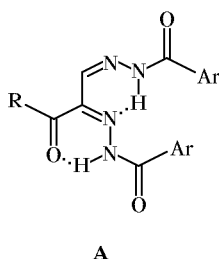
Unlike structurally related 2,3-bis(phenylhydrazono)-propionic acid esters and amides [1], the ^1H NMR spectra of compounds **III** and **IV** do not change with time, and the position of the NH and OH signals is retained. The amide NH signals of **III** and **IV** appear in a weaker field, as compared with analogous osazones [1], due to formation of intramolecular hydrogen bonds and strong electron-acceptor effect of

the aryl substituent on the nitrogen atom. Weakening of the electron-acceptor power of the carbonyl group due to hydrogen bonding, e.g., with phenolic hydroxy group in **IIIc** and **IIIc**, results in upfield shift of the NH signal by 0.1–0.34 ppm (δ 12.45–12.52 ppm) and 0.4 ppm (δ 14.65 ppm) relative to those of **IIIa** and **IIIb**. However, no such signal shift is observed for osazones **IIIa** and **IIIb**.

Scheme 2.



The mass spectrum of **IVa** contains the molecular ion peak with m/z 427 (I_{rel} 37%) and fragment ion peaks, m/z (I_{rel} , %): 322 (17) [$M-\text{COPh}$]⁺, 293 (10) [$M-\text{PhCONNH}$]⁺, 106 (18) [PhCH_2NH]⁺, 105 (100) [PhCO]⁺, 77 (81) [Ph]⁺; these data are consistent with the assumed structure. The structure of compounds **III** and **IV** may be represented by a set of molecular sketches with different intramolecular hydrogen bonds; however, in keeping with the spectral data, H-chelate structure like **A** is typical of compounds **IIIa**, **IIIb**, and **IVa**, and compounds **IIIc**, **IIIb**, **IVb**, and **IVc** are likely to have structure **B**.



Presumably, compounds **III** and **IV** are formed by analogy to osazones obtained from diazo compounds **I** and **II** and phenylhydrazine [1]. The reaction begins with attack by hydrazide on the ketone carbonyl group of the substrate, leading to intermediate **Int**₁ (Scheme 2) which reacts with excess hydrazide with subsequent elimination of water molecule or loses water molecule to form diazo hydrazone **Int**₂ which then reacts with excess hydrazide. The N_2CH group in **Int**₁ and **Int**₂ acts like hydroxy group in sugars in the synthesis of osazones with substituted hydrazines.

EXPERIMENTAL

The IR spectra were recorded on a UR-20 or Specord M-80 instrument in mineral oil. The ¹H NMR spectra were obtained on RYa-2310 (60 MHz) and Bruker WR-80SY (80 MHz) instruments using HMDS as internal reference and DMSO-*d*₆ as solvent. The mass spectrum (70 eV) was recorded on a Varian MAT-311A spectrometer; emission current 1000 mA, vaporizer temperature 120–150°C, ion source temperature 200°C. The progress of reactions and the purity of products were monitored by TLC on Silufol UV-254 plates in the system ether–benzene–acetone (10:9:1).

2,3-Bis(arylohydrazone)propionic acid esters and amides IIIa–IIIb and IVa–IVc. A solution of 0.01 mol of compound **I** or **II** and 0.03 mol of benzohydrazide or salicylic hydrazide in 50 ml of dioxane was refluxed for 12–24 h. The solvent was distilled off, and the residue was recrystallized from alcohol.

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