The Reactions of Bisamides with Oxalyl Chloride

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Alkylidenebisamides and alkylidenebiscarbamates were found to react with oxalyl chloride to give oxazolidinediones (**2**), a diazepinedione (**3**) or fragmentation products depending on the nature of the substituents (R′ in formula **1**).

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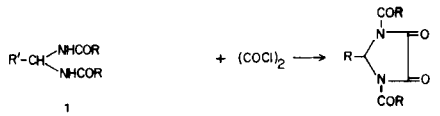
Methylidenebisbenzamide (**1**, R = Ph, R′ = H) and methylidenebisacetamide (R = Me, R′ = H) were recently reported to react with oxalyl chloride to give imidazolidine-4,5-diones (1).



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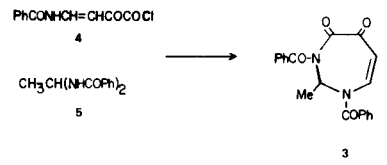
When we tried to extend the reaction to other bisamides and biscarbamates we found that the reaction is strongly dependent on the nature of the R′ groups of the bisadducts (**1**). The reaction proceeds in good yield when R′ is an electron withdrawing group (Table). When R′ is an electron donating group only decomposition products are obtained. Adducts of higher aliphatic aldehydes (**1**, R′ = Me, Et, *iso*-Pr, *t*-Bu) did not afford, under the same reaction conditions, any imidazolidin-4,5-diones. In the case of ethylidene bisbenzamide (**1**, R = Ph, R′ = Me), a yellow solid was obtained in good yield which showed a molecular peak m/e = 348 in the mass spectrum. It also showed CO absorptions at 1760, 1710, and 1700 and a very strong band at 1610 cm^{-1}, and lacked NH absorptions in the 3400 and 1510 regions of the infrared.

The nmr spectrum showed aromatic absorptions at δ 7.66 (12H) a quartet at 5.38 (1H), and a doublet at 1.61 (3H); By means of a Europium complex, two vinyl protons were shifted from the aromatic region to lower field. Based on the above information, a 1,3-diazepene-3,4-dione (**3**) structure is suggested for the yellow product. A plausible mechanism for its formation is the



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intermidiate formation of *N*-vinylbenzamide which reacts further with oxalyl chloride to give the acid chloride **4**. Compound **4** condenses with a second molecule of the bisadduct **5** to give a diazepene intermidiate which looses benzamide to give **3**. In the case of the other bisadduct

Table

Oxazolidine-4,5-diones (**3**)

	R	R′	Yield	M.p. %		Analysis Calcd. C	H	N	Found C	H	N
a	Ph	H	62	255-258 dec.	$C_{17}H_{12}N_2O_4$	66.23	3.92	9.09	65.70	4.25	8.88
b		$CO_2C_4H_9$	90	164-165	$C_{22}H_{20}N_2O_6$	64.70	4.94	6.86	64.32	6.86	6.81
c		*p*-$O_2NC_6H_4$	76	260-262	$C_{23}H_{15}N_3O_6$	64.33	3.52	9.79	64.34	3.49	9.26
d	MeO	CO_2CH_3	55	159-160	$C_9H_{10}N_2O_8$	39.42	3.68	10.22	39.58	3.57	10.20
e	EtO	$CO_2C_4H_9$	32	75-76	$C_{14}H_{20}N_2O_8$	48.83	5.86	8.14	48.83	5.90	8.05
f	$PhCH_2O$	H	66	181-182	$C_{19}H_{16}N_2O_6$	61.95	4.38	7.61	61.85	4.70	7.48
g		$CO_2C_4H_9$	35	125-126	$C_{24}H_{24}N_2O_8$	66.04	5.54	6.42	66.31	5.21	6.11

derived from aliphatic aldehydes we isolated only decomposition products like benzamide, dibenzoy urea, benzonitrile and benzoyl isocyanate.

EXPERIMENTAL

Melting points are uncorrected, ir spectra were carried out on a Perkin Elmer 257 spectrometer and nmr spectra were measured on a Varian T-60 spectrometer.

Preparation of Starting Materials.

The bisamides used in the reactions were prepared by either of two methods: A. Refluxing the aldehyde and two molar equivalents of the amide in benzene with a sulfonic acid catalyst and concurrent azeotropic removal of the water by means of a Dean Stark apparatus (3). B. Stirring at room temperature in glacial acetic acid with hydrogen bromide as catalyst in the same aldehyde: amide (1:2) ratio (4). Using procedure A we have prepared butyl glyoxylatebisbenzamide (**1b**) (m.p. 206-207°), butyl glyoxylatebisthylcarbamate (**1e**) (m.p. 129-130°), butyl glyoxylatebisbenzylcarbamate (**1g**) (m.p. 136-137°) and methyl glyoxylatebismethylcarbamate (**1d**) (m.p. 158-159°) in 89-90% yield. By procedure B we have prepared ethylidene bisbenzamide, propylidenebisbenzamide and *t*-butylidenebisbenzamide (4). The synthesis of methylidenebisbenzamide methylidenebisbenzyl carbamate (5) and *p*-nitrobenylidenebisbenzamide was described in the literature (3).

1,3-Dibenzoyl-2-carbobutoxyimidazolidene-4,5-dione (**2b**).

To a stirred solution of the bisamide **1b** (3.54 g., 0.01 mole) in dichloromethane (75 ml.) at room temperature was added dropwise oxalyl chloride (2.54 g., 0.02 mole). After 48 hours stirring at room temperature, the solvent was removed and the gummy residue was triturated overnight with absolute ether (20 ml.). Filtration and crystallization from ethyl acetate gave 2.95 g. (77%) of product, m.p. 163-165°; ir (chloroform): 1805, 1780, 1720 and 1710 cm^{-1}; nmr (DMSO): δ 0.8 (m, 7H), 4.23 (t, 2H), 6.63 (s, 1H), 7.7 (m, 10H).

1,3-Dimethoxycarbonyl-2-carbomethoxyimidazoline-4,5-dione (**2d**).

A solution of the bisadduct **1d** (1.1 g., 0.005 mole) oxalyl chloride (1.27 g., 0.01 mole) in benzene (50 ml.) was refluxed for 48 hours. Evaporation of the solvetn and crystallization from ethyl acetate-petroleum ether gave 0.75 g. of product, m.p. 159-160°; ir (chloroform): 1820, 1790, and 1760 cm^{-1}; nmr (deuteriochloroform): 3.93 (s, 3H), 4.06 (s, 6H), 6.0 (s, 1H).

1,3-Diethoxycarbonyl-2-carbobutoxyimidazoline-4,5-dione (**2e**).

This compound was prepared by the procedure described above, yield 25%, m.p. 75-76°.

1,3-Dibenzyloxycarbonyl-2-carbobutoxyimidazoline-4,5-dione (**2g**).

A solution of the bisadduct (2.07 g., 0.005 mole) and oxalyl chloride (1.27 g., 0.01 mole) in benzene (50 ml.) was refluxed for 48 hours. The solvent was evaporated and the residue was dissolved in ether (100 ml.) with water (2 x 30 ml.), dried (magnesium sulfate), washed, filtered, and evaporated. Trituration of the residue with ether-petroleum ether (1:10) and crystallization of the solid from ethyl acetate-petroleum ether gave 0.62 g. (26%) of a product, m.p. 125-126°; ir (potassium bromide): 1815, 1805, 1785, and 1745 cm^{-1}; nmr (deuteriochloroform): δ 0.53-1.66 (m, 7H), 4.08 (t, 2H), 5.40 (s, 4H), 5.93 (s, 1H) and 7.43 (s, 10H).

1,3-Dibenzyloxycarbonylimidazoline-4,5-dione (**2f**).

This compound was prepared from **1f** (0.01 mole) and oxalyl chloride (0.03 mole) as described above. Crystallization from methanol gave 1.9 g. (66%) of crystalline **2f**, m.p. 181-182°; ir (potassium bromide): 1830, 1815, 1790, and 1755 cm^{-1}; nmr (deuteriochloroform): δ 5.23 (s, 2H), 5.40 (s, 4H) and 7.43 (s, 10H).

1,3-Dibenzoyl-2-methyl-1,3-diazep-6-ene-4,5-dione (**3**).

Oxalyl chloride (25.4 g., 0.20 mole) was added dropwise to a suspension of ethylidenebisbenzamide (13.4 g., 0.05 mole) in dichloromethane (250 ml.), stirred at room temperature. The solution was evaporated to dryness after 24 hours and the gummy residue was triturated overnight with absolute ether (200 ml.) and filtered to give 6.37 g. of a yellow solid which was crystallized from absolute methanol, yield 4.30 g. (49%), m.p. 184-185°; ir (chloroform): 1760, 1710, 1700, and 1610 cm^{-1}; nmr (deuteriochloroform): δ = 1.61 (d, 3H, J = 6.5 c/s) 5.38 (q, 1H, J = 6.5 c/s), 7.66 (m, 12H); mass spectrum m/e: 348 (M^+), 245, 173, 105, 87, 51, and 28. By means of a Europeum complex two vinyl protons were shifted from the aromatic region to lower filed where they appeared as a doublet.

Anal. Calcd. for $C_{20}H_{16}N_2O_4$: C, 68.96; H, 4.63; N, 8.04. Found: C, 68.93, H, 4.55; N, 8.05.

REFERENCES AND NOTES

(1) R. Kunstler, *et al.*, British Patent 1,255,767; *Chem. Abstr.*, **76**, 34254v (1972).

(2) B. C. Challis and J. Challis in "The Chemistry of Amides", J. Zabitcky, Ed., Interscience Publishers, John Wiley and Sons, New York, 1970. Chapter 13, p. 770.

(3) S. W. Breuer, T. Bernath, and D. Ben-Ishai, *Tetrahedron*, **23**, 2869 (1967).

(4) R. Giger and D. Ben-Ishai, *Israel J. Chem.*, **5**, 253 (1967).

(5) N. Tadashi and I. Keiichiro, *Kogo Kagaku Zasshi*, **66**, 514 (1963); *Chem. Abstr.*, **59**, 15398d (1963).