Synthesis and Reactions of Some 2-Aryl-4-Arylidene-5 (4)-Oxazolones

A.A.AFIFI, M.A.I. SALEM, M.A.EL-HASHASH AND S.S.EL-KADY
Chemistry Department, Faculty of Science, Ain Shams University, Cairo, Egypt

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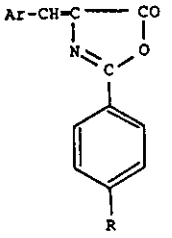
2-Aryl-4-arylidene-5(4)-oxazolones (I) reacted with amines in ethanol to give α-arylcarboxamido-β-arylacrylamides (II) and (III) and in acetic acid to give α-4-arylideneimidazolinones (IV). Compounds (I) reacted also with hydrazines in ethanol to give the hydrazides (V) while with phenylhydrazine in acetic acid they give the 1:2:4-triazines (VI), the imidazolones (VII) resulting from the reaction of (I) with hydroxylamine hydrochloride were converted to the triazines (VI). Azidolysis of (I) gave β[tetrazolyl-(1)]-5-arylacrylic acids (VIII).

It was previously reported that the reaction of 2-aryl-4-arylidene-5 (4)-oxazolones with compounds like $R-NH_2$, etc. takes place by attack at C_5 with concomittant ring opening of the oxazolone ring [1-4].

In continuation of the previous work [1,2], some new 2-aryl-4-arylidene-5(4)-oxazolones (Ii) were prepared according to Erlenmayer procedure [5] by condensation of the respective aromatic aldehyde with the required aroylglycine in acetic anhydride in the presence of sodium acetate. The infrared spectra of compounds (I) showed strong absorption bands in the region 1800-1820 cm^{-1} corresponding to ν C=O of azlactone nucleus. The NMR spectrum of compounds (I) shows the following signals; δ 3.2 ppm (s) for 6H N $(CH_3)_2$, δ 6.8 (s) corresponding to olefinic proton and 7 (s), 7.6 (m) and 8.2 (m) corresponding to aromatic protons.

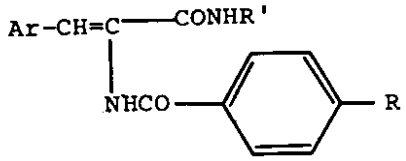


(I)

	Ar	R		Ar	R
a,	C_6H_5	Cl	f,	$C_6H_4NO_2$(m)	CH_3
b,	C_6H_4Cl(o)	CH_3	g,	C_6H_4NO (p)	Cl
c,	C_6H_4Cl(m)	Cl	h,	$C_6H_4N(CH_3)_2$(p)	NO_2
d,	C_6H_4Cl(p)	CH_3	i,	$C_6H_4N(CH_3)_2$(p)	Cl
e,	C_6H_4Br(o)	NO_2			

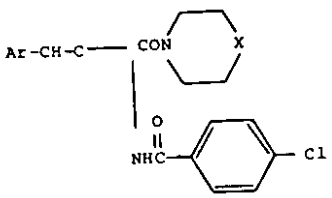
The 2-aryl-4-arylidene-5 (4)-oxazolones (Ia), (c),(f), & (g) reacted readily with various amines in ethanol solution to give the corresponding α-arylcarboxamido-β-arylacrylamides (II) and (III) [1]. The structure of these compounds was supported by elemental analysis and by IR measurements which showed two amide carbonyl bands in the region 1660-1650 cm^{-1} and 1640-1630 cm^{-1} respectively, and two NH bands at 3380-3320 cm^{-1}.

When the reaction between amines and 4-arylidene-oxazolones (I) was carried out in acetic acid solution,



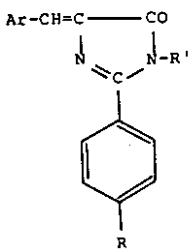
(II)

	Ar	R	R'
a,	C_6H_5	Cl	$(CH_2)_3CH_3$
b,	C_6H_5	Cl	C_6H_{11}
c,	C_6H_5	Cl	$CH_2C_6H_5$
d,	C_6H_4Cl(m)	Cl	$(CH_2)_3CH_3$
e,	C_6H_4Cl(m)	Cl	C_6H_{11}
f,	C_6H_4Cl(m)	Cl	$CH_2C_6H_5$
g,	$C_6H_4NO_2$(m)	CH_3	C_6H_{11}
h,	$C_6H_4NO_2$(m)	CH_3	$C_6H_3(CH_3)_2$(3,4)
i,	$C_6H_4NO_2$(m)	CH_3	$C_6H_3(CH_3)Cl$(2,5)
j,	$C_6H_4NO_2$(m)	CH_3	$C_6H_4NH_2$(o)
k,	$C_6H_4NO_2$(m)	CH_3	$C_6H_4NH_2$(p)
l,	$C_6H_4NO_2$(p)	Cl	$C_6H_4NH_2$(o)
m,	$C_6H_4NO_2$(p)	Cl	$C_6H_4NH_2$(p)



(III)

	Ar	X
a,	C_6H_5	CH_2
b,	C_6H_5	O
c,	C_6H_4Cl(m)	CH_2
d,	C_6H_4Cl(m)	O
e,	$C_6H_4N(CH_3)_2$(p)	O



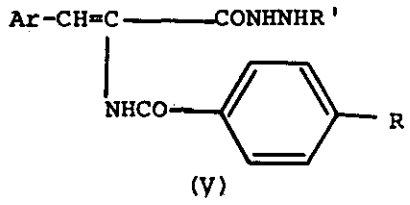
(IV)

	Ar	R	R'
a,	$C_6H_4NO_2$(p)	Cl	$C_6H_4CH_3$(p)
b,	$C_6H_4NO_2$(p)	H	$C_6H_4CH_3$(p)

in the presence of fused sodium acetate, the corresponding 4-arylidene imidazolinones (IV) were obtained [6]. It seems that (I) passes first to the open chain structure (II) which recyclises to the imidazolinone (IV). This mechanism was verified when some of the open-chain arylacrylamides (II) were heated in acetic acid in the presence of sodium acetate to give the corresponding imidazolinones (IV).

The structure of the imidazolinones (IV) was established by elemental analysis and by the fact that they gave no colouration with ferric chloride solution, in contrast to the parent compounds (II). The structures were also supported by IR measurements which showed stretching frequencies at 1685 cm^{-1} and 1640 cm^{-1} characteristic for -CONR'- and -C=N- respectively.

Compounds (I) react with hydrazines in ethanol solution to give the normal hydrazides (V) [1]. The IR spectra of (V) showed νC=O of the hydrazide in the region 1680-1690 cm^{-1} and a broad νNH band at 3200 cm^{-1}.

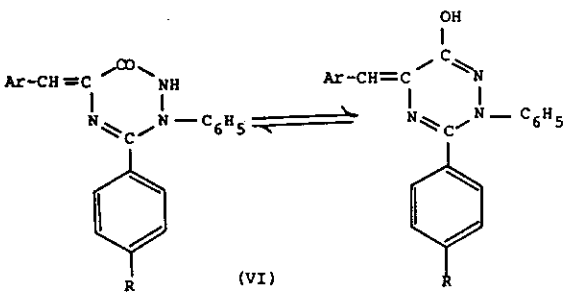


(V)

	Ar	R	R'		Ar	R	R'
a,	C_6H_5	Cl	H	e,	C_6H_5	Cl	C_6H_5
b,	C_6H_4Cl (m)	Cl	H	f,	C_6H_4Cl (m)	Cl	C_6H_5
c,	C_6H_4Br (o)	NO	H	g,	$C_6H_4NO_2$ (m)	CH_3	C_6H_5
d,	$C_6H_4(CH_3)$ (p)	Cl	H	h,	$C_6H_4N(CH_3)_2$ (p)	NO_2	C_6H_5

All trials [7] of cyclisation of the hydrazides (V; R=H) in the presence of acetic acid and sodium acetate to the corresponding 1;2:4-triazine derivatives were unsuccessful. It seemed that decomposition took place as indicated by rapid evolution of nitrogen (frothing). The phenylhydrazides (Ve) and (Vf) were readily cyclised, however, under the above conditions to give the corresponding triazines (VIa) and (VIb) respectively [6].

Interaction of oxazolones (Ia) and (Ic) with phenylhydrazine in acetic acid solution and in presence of sodium acetate give directly the required 1:2:4-triazines (VI).

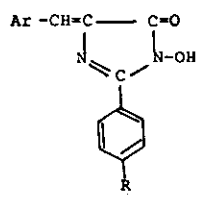


(VI)

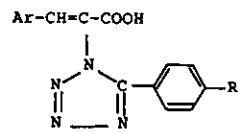
Ar	R	Ar	R
a, C_6H_5	Cl	b, C_6H_4Cl (m)	Cl

The structure of the triazines (VI) was based on analytical data and on IR measurements which showed stretching frequencies at 1650 cm^{-1}, 3280 and 3350 cm^{-1} characteristic for -CONH-, OH and NH- groups respectively. These bands illustrate that compounds (VI) exist actually in lactam-lactim tautomeric equilibrium.

The oxazolones (Ia), (c), (e) and (h) reacted with hydroxylamine hydrochloride in pyridine to give 4-arylidene-1-hydroxy-2-aryl-5-imidazolones (VII) [3]. Compounds (VII) showed in the infrared νC=O in the region 1680-1700 cm^{-1}, νC=N at 1630 cm^{-1} and ν OH in the region 3350-3340 cm^{-1}.



(VII)



(VIII)

Ar	R	Ar	R
a, C_6H_5	Cl	a, C_6H_5	Cl
b, C_6H_4Cl (m)	Cl	b, C_6H_4Cl (m)	Cl
c, C_6H_4Br (o)	NO_2	c, C_6H_4Br (o)	NO_2
d, $C_6H_4N(CH_3)_2$ (p)	NO_2	d, $C_6H_4N(CH_3)_2$ (p)	NO_2

Compounds (VIIa) and (VIIb) react with phenylhydrazine in ethanol or acetic acid to give the triazines (VI) [3].

2-aryl-4-Arylidene-5(4)-oxazolones (I) reacted with sodium azide in acetic acid to give α-[tetrazolyl-(1)]-5-aryl cinnamic acid derivative (VIII) [1]. The IR spectra of (VIII) showed OH stretching frequency in the region 3300-3350 cm^{-1} (broad). ν C=O at 1710 cm^{-1} and ν tetrazolyl ring at 1100-900 cm^{-1}.

Thus azidolysis of (I) involves opening of C_2-O bond contrary to the normal ring opening of the 5(4)-oxazolone ring (fission of C_5-O bond) in the reaction with all other compounds (viz. RNH_2, RNH-NH, etc.).

Experimental

Melting points are not corrected. IR spectra were measured on a Beckman IR-20 infrared spectrometer, using KBr wafer technique, the NMR spectrum were determined using a Varian VN 1009 (S-60T) instrument, using $CDCl_3$ as a solvent and TMS as internal standard.

2-Aryl-4-Arylidine-5(4)-Oxazolone (I)

A mixture of aromatic aldehyde (0.12 mole), aroylglycine (0.1 mole), acetic anhydride (20 ml), and sodium acetate (0.5 g) was heated on a steam bath for 3 hours then cooled. A solid product was obtained which was recrystallized from the given solvent as listed in Table 1.

Reaction of Oxazolones (I) with amines

(a) Formation of α-Arylcarboxamido-β-Arylacrylamides (II and III)

A solution of I (0.01 mole) and the requisite amine (0.01 mole) in ethanol (60 ml) was heated under

Table-1: Oxazolones (I)

Comp.	M.P. (°C)	Solvent	Formula	Analysis % Found			Required		
				C	H	N	C	H	N
(Ia)	180	B	$C_{16}H_{10}O_2NCl$	67.53	3.30	4.52	67.72	3.52	4.93
(Ib)	160	B	$C_{17}H_{12}O_2NCl$	68.15	4.01	4.51	68.57	4.03	4.70
(Ic)	188	B	$C_{16}H_9O_2NCl_2$	60.03	2.75	4.82	60.37	2.83	4.40
(Id)	172	B	$C_{17}H_{12}O_2NCl$	68.75	4.22	4.95	68.57	4.03	4.70
(Ie)	225	B	$C_{16}H_9O_4N_2Br$	51.21	2.31	7.12	51.48	2.41	7.50
(If)	180	E	$C_{17}H_{12}O_4N_2$	66.63	3.59	9.38	66.23	3.89	9.09
(Ig)	80	B	$C_{16}H_9O_4N_2Cl$	58.34	2.91	8.75	58.44	2.73	8.52
(Ih)	218	T	$C_{18}H_{15}O_4N_3$	64.38	4.15	12.12	64.09	4.45	12.46
(Ii)	196	T	$C_{18}H_{15}O_2N_2Cl$	66.51	4.34	8.87	66.15	4.59	8.57

Table-2: α-Arylcarboxamido-β-arylacrylamides (II) and (III)

Comp	M.P.	Solvent	Formula	Analysis % Found			Required		
				C	H	N	C	H	N
(IIa)	150	E	$C_{20}H_{21}O_2N_2Cl$	67.11	5.59	7.74	67.32	5.89	7.85
(IIb)	210	E	$C_{22}H_{23}O_2N_2Cl$	69.24	6.21	7.61	69.10	6.01	7.32
(IIIc)	155	E	$C_{23}H_{19}O_2N_2Cl$	70.92	4.59	7.29	70.67	4.86	7.17
(IId)	200	L.P.	$C_{20}H_{20}O_2N_2Cl_2$	61.21	5.32	7.56	61.38	5.11	7.16
(IIe)	218	B	$C_{22}H_{22}O_2N_2Cl_2$	63.61	5.21	6.42	63.30	5.27	6.71
(IIf)	170	B	$C_{23}H_{18}O_2N_2Cl_2$	64.73	4.54	6.53	64.94	4.23	6.58
(IIg)	130	B	$C_{23}H_{25}O_4N_3$	67.52	6.23	10.01	67.81	6.14	10.31
(IIh)	220	E	$C_{25}H_{23}O_4N_3$	69.71	5.21	9.51	69.83	5.36	9.79
(IIi)	136	B	$C_{24}H_{20}O_4N_3Cl$	64.31	4.65	9.11	64.07	4.45	9.34
(IIj)	230	B	$C_{23}H_{20}O_4N_4$	66.59	4.58	13.66	66.35	4.81	13.46
(IIk)	202	B	$C_{23}H_{20}O_4N_4$	66.01	4.58	13.01	66.35	4.81	13.46
(III)	290	A	$C_{22}N_{17}O_4N_4Cl$	60.12	3.67	12.31	60.48	3.89	12.83
(IIm)	256	A	$C_{21}H_{21}O_2N_2Cl$	60.72	3.63	12.32	60.48	3.89	12.83
(IIIa)	218	E	$C_{20}H_{19}O_3N_2Cl$	68.83	5.49	7.02	68.39	5.69	7.59
(IIIb)	205	L.P.	$C_{20}H_{19}O_3N_2Cl$	64.51	5.33	7.05	64.77	5.13	7.55
(IIIc)	175	L.P.	$C_{21}H_{20}O_2N_2Cl_2$	62.02	4.76	6.72	62.53	4.96	6.95
(IIId)	199	B	$C_{20}H_{18}O_3N_2Cl_2$	59.01	4.24	6.52	59.25	4.44	6.91
(IIIe)	235	B	$C_{22}H_{24}O_3N_3Cl$	63.44	5.72	10.63	63.84	5.80	10.16

reflux for 30 minutes and cooled. The solid products obtained after acidification with dilute hydrochloric acid were filtered and recrystallized from suitable solvent as listed in Table 2.

b) Formation of 1,2-Diaryl-4-Arylidene-2-Imidazolin-5-Ones (IV)

A mixture of oxazolone (I) (0.01 mole), p-toluidine (0.01 mole) and fused sodium acetate (0.3 g) in acetic

Table-3: Arylidene Imidazolinones (IV), Hydrazides (V), Triazine (VI) Imidazolones (VII) and Tetrazolyl derivatives (VIII)

Comp.	M.P. °C	Solvent	Formula	Analysis % Found			Required		
				C	H	N	C	H	N
(IVa)	120	E	$C_{23}H_{16}N_3O_3Cl$	66.51	3.62	9.83	66.11	3.83	10.05
(IVb)	145	E	$C_{23}H_{17}N_3O_3$	72.66	4.44	10.96	71.85	4.32	10.26
(Va)	210	E	$C_{16}H_{14}O_2N_3Cl$	60.45	4.30	13.00	60.85	4.49	13.31
(Vb)	190	E	$C_{16}H_{13}O_2N_3Cl_2$	54.72	3.61	12.20	54.85	3.71	12.00
(Vc)	228	E	$C_{16}H_{13}O_4N_4Br$	47.71	3.22	13.62	47.41	3.21	13.83
(Vd)	202	B	$C_{18}H_{19}O_2N_4Cl$	60.10	5.42	15.70	60.25	5.29	15.62
(Ve)	160	L.P.	$C_{22}H_{18}O_2N_3$	67.21	4.81	10.31	67.43	4.59	10.72
(Vf)	155	E	$C_{22}H_{17}O_2N_3Cl_2$	61.71	3.72	9.42	61.97	3.99	9.85
(Vg)	178	B	$C_{23}H_{20}O_4N_4$	66.23	4.75	13.23	66.34	4.80	13.46
(Vh)	230	L.P.	$C_{24}H_{23}O_4N_5$	64.41	5.01	15.32	64.71	5.16	15.73
(VIa)	205	M	$C_{22}H_{16}ON_3Cl$	70.51	4.31	11.74	70.68	4.28	11.24
VIb	230	E	$C_{22}H_{15}ON_3Cl_2$	64.45	3.91	10.01	64.70	3.67	10.29
(VIIa)	190	B	$C_{16}H_{11}O_2N_2Cl$	64.12	3.51	9.01	64.32	3.68	9.38
(VIIb)	200	B	$C_{16}H_{10}O_2N_2Cl_2$	57.48	3.31	8.31	57.65	3.00	8.40
(VIIc)	240	B	$C_{16}H_{10}O_4N_3Br$	49.25	2.31	10.52	49.49	2.57	10.82
(VIId)	175	B	$C_{18}H_{16}O_4N_4$	66.45	4.23	15.51	66.46	4.54	15.90
(VIIIa)	218	B	$C_{16}H_{11}O_2N_4Cl$	58.61	3.31	17.25	58.80	3.36	17.15
(VIIIb)	209	A	$C_{16}H_{10}O_2N_4Cl_2$	53.38	2.61	15.45	53.18	2.77	15.51
(VIIIc)	235	B	$C_{16}H_{10}O_4N_5Br$	46.31	2.52	16.53	46.16	2.40	16.83
(VIIId)	225	E	$C_{18}H_{16}O_4N_4$	61.35	4.59	15.81	61.36	4.54	15.90

A = Acetic acid, B = Benzene, E = Ethanol,
M = Methanol, L.P. = light petroleum (b.p. 80-100°),
T = Toluene.

acid (80 ml) was heated under reflux for one hour. Dilution with water gave the product (IV) which was collected and crystallized from ethanol (Table 3).

Reaction of Oxazolones (I) with Hydrazines

(a) Formation of Hydrazides (V)

A solution of (I) (0.1 mole) and hydrazine hydrate, or phenylhydrazine (0.1 mole) in ethanol (60 ml) was heated under reflux for 1 hour. Acidification with cold dilute hydrochloric acid (pH 5) gave the hydrazides (V) which were collected and crystallized (Table 3).

(b) Cyclisation of Hydrazides (V) to Triazines (VI)

i) The hydrazides (V); R'-H) (0.01 mole) in acetic acid (60 ml) and in presence of fused sodium acetate (0.2 g) was heated under reflux for 45 minutes; much frothing took place. Decomposition of the cold reaction mixture with water gave sticky products from which no crystalline materials was obtained.

ii) When the hydrazides (Ve) and (Vf) were treated as in the above experiment the corresponding 1:2:4-triazines (VI) were obtained (Table 3).

iii) The oxazolone (I) (0.01 mole) and phenylhydrazine (0.01 mole) in acetic acid (60 ml) and in presence of fused sodium acetate (0.3 g) were heated under reflux for 1 hour. Dilution with water gave the corresponding 1:2:4-triazines (VI) which recrystallized from the proper solvent (Table 3).

Reaction of Oxazolones with Hydroxylamine Hydrochloride

A solution of I (0.1 mole), pyridine (50 ml) and hydroxylamine hydrochloride (0.1 mole) was heated under reflux for 6 hours and then cooled. The solid product was filtered off and recrystallized from suitable solvent as listed in (Table 3).

Action of Hydrazine on the Imidazolones

A solution of imidazolone (0.1 mole) in ethanol or acetic acid was treated with phenylhydrazine (0.1 mole). The reaction mixture was heated under reflux for 3 hours then cooled. The solid products were filtered off and recrystallized from suitable solvent to the corresponding triazines (VI) (m.p. and mixed m.p.; cf. (Table 3).

Reaction of Sodium Azide with Oxazolones: Formation of Tetrazolyl Derivatives (VIII)

A solution of (I) (0.1 mole) in hot acetic acid (30 ml) was treated with sodium azide (0.4 mole) dissolved in the least amount of water and the reaction mixture heated under reflux on a steam bath for 3 hours then poured on crushed ice. The solid product was filtered off and recrystallized from the proper solvent to give (VIII) (Table 3).

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