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NEW COMPOUNDS

Action of Hydrazines, Hydroxylamine, and Urea on 2-Aryl-4-(chloromethyl)-1,3,4-oxadiazoline-5-thiones

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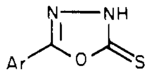
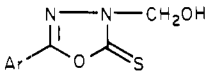
2-Aryl-4-(chloromethyl)-1,3,4-oxadiazoline-5-thiones (III) reacted with hydrazines, hydroxylamine hydrochloride, urea, and thiourea forming compounds IV–IX. The structures of the newly prepared compounds were established by IR, UV, ^{1}H NMR, and mass-spectral studies.

The literature reveals that 2-aryl-1,3,4-oxadiazoline-5-thiones possess sedative effects (*1*), antitubercular activity (*2*), and analgesic and antiphlogistic properties (*3*, *4*). The following compounds are prepared to test them for biological activity.

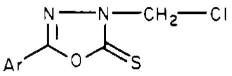
2-Aryl-1,3,4-oxadiazoline-5-thiones (I) (*5–7*) reacted with



I



II



III

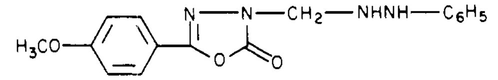
I-IIIa, Ar = C_6H_5
I-IIIb, Ar = $C_6H_4CH_3$-*p*
I-IIIc, Ar = $C_6H_4OCH_3$-*p*
I-IIId, Ar = C_6H_4Cl-*p*

formaldehyde to form 2-aryl-4-(hydroxymethyl)-1,3,4-oxadiazoline-5-thiones (II). Compounds II reacted with thionyl chloride, yielding 2-aryl-4-(chloromethyl)-1,3,4-oxadiazoline-5-thiones (III) (*8*).

In the present investigation the action of hydrazines, hydroxylamine, urea, and thiourea on III was attempted.

Compounds III reacted with hydrazines, namely hydrazine hydrate, phenylhydrazine, *p*-nitrophenylhydrazine, and 2,4-dinitrophenylhydrazine, yielding 2-aryl-4-(hydrazinomethyl)-Δ^2-1,3,4-oxadiazoline-5-thione (IV) (see Chart I).

Oxidation of IVi with potassium permanganate in acetic acid afforded the corresponding oxo derivative, V (*9*).



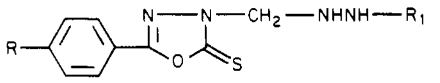
V

Compounds IVa,e,h,l were cyclized with the elimination of hydrogen sulfide on heating in an oil bath at 5–10 °C over their melting points yielding 2,3-dihydro-6-phenyl-*s*-triazolo[3,4-*b*]-[1,3,4]-oxadiazole (VI) (see Chart II). Compounds VI reacted with methyl iodide, forming compounds VIIa–c.

Compounds III reacted also with hydroxylamine hydrochloride, urea, and thiourea, yielding 2-aryl-4-(aminomethyl)-Δ^2-1,3,4-oxadiazoline-5-thione (VIII) (see Chart III). Oxidation of VIIIe with alkaline potassium permanganate in acetic acid afforded the corresponding oxo derivative, IX.

The structure of the newly prepared compounds is confirmed by IR, UV, ^{1}H NMR, and mass-spectral studies.

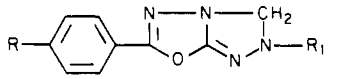
Chart I



IV

IV	R	R_1	mp, °C
a	H	H	210
b	H	C_6H_5	198
c	H	$C_6H_4NO_2$-*p*	145
d	H	$C_6H_3(NO_2)_2$-2,4	200
e	CH_3	H	215
f	CH_3	C_6H_5	178
g	CH_3	$C_6H_4NO_2$-*p*	182
h	OCH_3	H	170
i	OCH_3	C_6H_5	151
j	OCH_3	$C_6H_4NO_2$-*p*	110
k	OCH_3	$C_6H_3(NO_2)_2$-2,4	206
l	Cl	H	205
m	Cl	C_6H_5	200
n	Cl	$C_6H_4NO_2$-*p*	162

Chart II

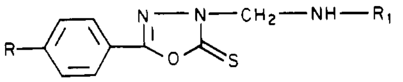


VI, VII

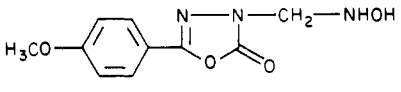
VI	R	R_1	mp, °C
a	H	H	185
b	CH_3	H	189
c	OCH_3	H	201
d	Cl	H	164

VII	R	R_1	mp, °C
a	H	CH_3	149
b	CH_3	CH_3	154
c	Cl	CH_3	163

Chart III



VIII



IX

VIII	R	R_1	mp, °C	VIII	R	R_1	mp, °C
a	H	OH	104	e	OCH_3	OH	104
b	H	$CONH_2$	95	f	OCH_3	$CONH_2$	108
c	H	$CSNH_2$	213	g	OCH_3	$CSNH_2$	160
d	CH_3	OH	110	h	Cl	OH	193

Experimental Section

The IR (KBr) spectra were recorded with a UNICAM S.P. 1200 spectrophotometer. The UV (ethanol) spectra were recorded with a UNICAM S.P. 800 spectrophotometer. The ^{1}H NMR spectra (see Table I) were recorded at 60 MHz on a Varian A-60 spectrometer. The mass spectra (see Table II) were recorded on a V.G. Micromass 7070 F spectrometer

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Table I. ^1H NMR Spectral Data for Compounds IV–VIII

compd	chem shift[a,b] aromatic	NH	OH[c]	CH_2[d]	$ArCH_3$[e]	$ArOCH_3$[e]
IVa	7.4–8.2 (5 H, m)	8.7 (3 H, s $NHNH_2$)		5.8		
IVb	6.8–8.0 (10 H, m)	10.8		4.4		
IVc	6.8–7.7 (4 H, dd)	4.4 (3 H, s)		4.9	1.9	
IVf	7.3–8.0 (9 H, m)	8.8 (3 H, s)		5.6	2.4	
IVg	7.2–7.8 (8 H, m)	3.3 (3 H, s)		5.9	2.3	
IVh	6.5–7.7 (4 H, dd)	3.4 (3 H, s)		4.3		3.7
IVi	6.9–8.1 (9 H, m)	3.9 (3 H, s)		5.8		3.8
VIa	7.3–8.0 (5 H, m)	3.3 (1 H, s)		5.5		
VIb	7.1–7.9 (4 H, dd)	3.3 (1 H, s)		6.0	2.2	
VIIa	7.0–7.8 (5 H, m)			6.0	2.2	
VIIIa	7.2–7.7 (5 H, m)	4.4 (1 H, s)	5.1	5.6		
VIIIb	7.2–7.7 (5 H, m)	4.3 (4 H, s, NH_2CONH_2)		5.5		
VIIIc	7.2–7.7 (5 H, m)	4.4 (4 H, s, NH_2CSNH_2)		5.6		
VIIId	7.2–7.9 (4 H, dd)	2.4 (1 H, s)	3.6	5.8	1.6	
VIIIe	6.9–7.9 (4 H, dd)	3.8 (1 H, s)	5.5	5.8		3.8
VIIIf	6.7–7.7 (4 H, dd)	4.5 (2 H, s) 5.1 (2 H, s, NH_2CONH_2)		5.7		
VIIIg	6.8–7.8 (4 H, dd)	3.7 (2 H, s) 3.9 (2 H, s, NH_2CSNH_2)		5.4		3.7
VIIIh	7.3–8.2 (5 H, m)	5.0 (1 H, s)	*f*	5.5		

[a] Chemical shifts (ppm) determined in Me_2SO or $CDCl_3$. [b] s = singlet; d = doublet; m = multiplet. [c] 1 H, s. [d] 2 H, s. [e] 3 H, s. [f] The OH proton perturbed with aromatic protons.

Table II. Mass-Spectral Data for Compounds IV–VIII

compd	M m/e	rel int, %	compd	M m/e	rel int, %
IVa	222	35.5	VIc	218	100
IVl	256.5	50	VIIIa	223	15.5
VIb	202	70	VIIIc	266	50

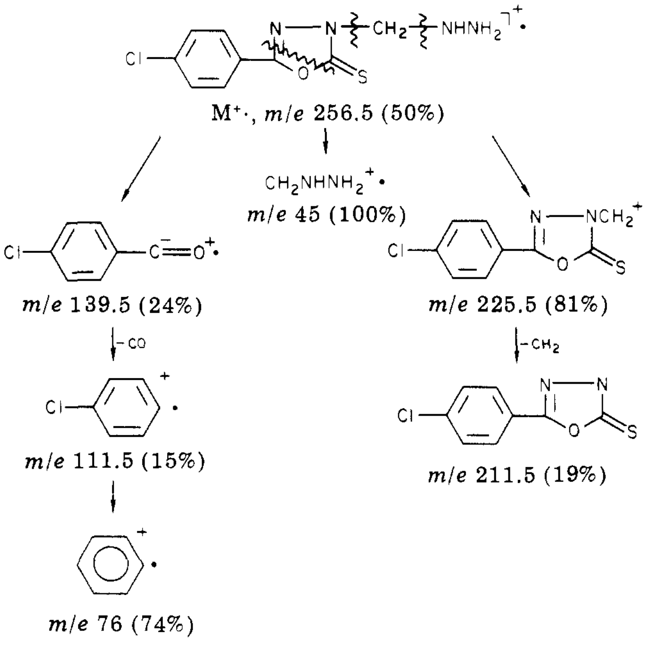

Table III

compd	$\lambda_{max}/\epsilon_{max} \times 10^{-4}$ π–π* phenyl	π–π* phenyl	π–π* oxadiazole
IVa	210/4.80	240/4.85	283/4.95
IVc		235/4.10	350/3.80[a]
IVd	210/4.60	255/4.45	380/4.85[a]

[a] Remarkable red shift due to the presence of a nitro group.

operating at 70 eV and using direct inlet. All melting points are uncorrected.

Satisfactory elemental analyses were found and were submitted for review.

Action of Hydrazines on 2-Aryl-4-(chloromethyl)-1,3,4-oxadiazoline-5-thiones (III). Formation of IV. Compound III (0.01 mol) and hydrazines (0.01 mol) in 50 mL of ethanol were refluxed for 3 h. The reaction mixture was concentrated, cooled, and filtered. The solid obtained was recrystallized from ethanol to give IVa–n in about 90% yield.

Oxidation of IVh with Potassium Permanganate. Potassium permanganate (0.46 g, 0.003 mol) in the least amount of water was added gradually to a solution of IVh (1 g) in acetic acid (50 mL). The reaction mixture was heated on a water bath for 0.5 h, concentrated, and cooled. The reaction mixture was poured on cold water, and the formed precipitate was filtered off and recrystallized from ethanol to give V in 80% yield, mp 138 °C.

Cyclization of IVa,d,h,l. In a dry conical flask 1 g of IVa,d,h or IVl was heated in an oil bath at 200–220 °C for 3 h. After being cooled the solid obtained was recrystallized from ethanol to give compounds VIa–d in almost quantitative yields.

Action of Methyl Iodide on VI. A mixture of VI (0.01 mol), methyl iodide (0.9 mL, 0.01 mol), and 30 mL of 0.1 N alcoholic sodium hydroxide was heated on a water bath for 2 h. The product obtained was triturated with light petrol and crystallized from benzene to give VIIa–c in about 75% yield.

Action of Hydroxylamine, Urea, and Thiourea on III. A mixture of III (0.01 mol) and hydroxylamine hydrochloride, urea, or thiourea (0.01 mol) in 50 mL of ethanol was refluxed for 3 h. The reaction mixture was recrystallized from ethanol to give VIIIa–h, yield 80–90%.

Oxidation of VIIIe with Potassium Permanganate. The same method used for the oxidation of IVh was used. Compound IX was obtained in 75% yield, mp 141 °C (methanol).

IR and UV Spectral Data of Some Products

The IR (KBr, cm^{-1}) spectral data of IVa (*10*, *11*) are as follows: 3410 (NH), 1615 (C=N), 1445 (CH_2), 1260 (C=S), 1070 (asym C—O), and 970 (sym C—O).

The UV (ethanol) spectral data of IVa,c,d (*10–15*) are provided in Table III.

Registry No. IIIa, 1711-76-8; IIIb, 81404-41-3; IIIc, 84586-96-9; IIId, 20128-95-4; IVa, 84587-00-8; IVb, 84586-97-0; IVc, 84586-98-1; IVd, 84586-99-2; IVe, 84587-01-9; IVf, 84587-02-0; IVg, 84587-03-1; IVh, 84587-04-2; IVl, 84587-05-3; IVj, 84587-06-4; IVk, 84587-07-5; IVl, 84587-08-6; IVm, 84587-09-7; IVn, 84587-10-0; V, 84587-11-1; VIa, 84587-12-2; VIb, 84587-13-3; VIc, 84587-14-4; VId, 84587-15-5; VIIa, 84587-16-6; VIIb, 84587-17-7; VIIc, 84587-18-8; VIIIa, 84587-19-9; VIIIb, 84587-20-2; VIIIc, 84587-21-3; VIIId, 84587-22-4; VIIIe, 84587-23-5; VIIIf, 84587-24-6; VIIIg, 84587-25-7; VIIIh, 84587-26-8; IX, 84587-27-9; $H_2NNH_2{\cdot}H_2O$, 7803-57-8; $PhNHNH_2$, 100-63-0; *p*-

$NO_2C_6H_4NHNH_2$, 100-16-3; $HONH_2 \cdot HCl$, 5470-11-1; $H_2NC(O)NH_2$, 57-13-6; $H_2NC(S)NH_2$, 62-56-6; 2,4-dinitrophenylhydrazine, 119-26-6.

Literature Cited

(1) Maffii, G.; Testa, E.; Ettore, R. *Farmaco, Ed. Sci.* **1958**, *13*, 187.
(2) Yoshida, S.; Asia, M. Japanese Patent 10 230, Nov 30, 1956.
(3) Wilder-Smith, A. E.; Frommel, E.; Radouco, T. S. *Arzneim.-Forsch.* **1963**, *13*, 338.
(4) Wilder-Smith, A. E. U.S. Patent, 3 127 410, 1964.
(5) Hoggarth, E. *J. Chem. Soc.* **1952**, 4811.
(6) Young, R. W.; Wood, K. H. *J. Am. Chem. Soc.* **1955**, *77*, 4400.
(7) Ainworth, C. *J. Am. Chem. Soc.* **1956**, *78*, 4475.
(8) Radha, I.; Srinivasan, V. R. *Indian J. Chem.* **1969**, *7*, 583.
(9) El-Barbary, A. A.; Hammouda, H. *Arch. Pharm.*, in press.
(10) Anwar, M.; Islam, I. *Delta J. Sci. Egypt* **1980**, *4*, 101.
(11) Ghatlas, A. A. Ph.D. Thesis, Cairo University, Cairo, Egypt, 1976.
(12) Sheinker, Yu. N.; Postovskii, Y. Ya.; Voronina, N. M. *Zh. Fiz. Khim.* **1959**, *33*, 302.
(13) Ainworth, C. *J. Am. Chem. Soc.* **1955**, *77*, 1148.
(14) Ainworth, C. *J. Am. Chem. Soc.* **1965**, *87*, 5800.
(15) El-Barbary, A. A.; Anwar, M.; Ghattas, A. A.; Hashem, A. F. *Rev. Roum. Chim.* **1981**, *26*, 449.
(16) Anwar, M.; El-Barbary, A. A.; Ghattas, A. A.; Hashem, A. F. *Pol. J. Chem.* **1981**, *55*, 599.

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Synthesis and Properties of Some *N*,*N*-Dialkylamides as New Extractants

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Forty-seven new *N*,*N*-dialkylamides were prepared and their physical and spectral data are tabulated. The solubility of amides 1–47 in organic and aqueous solvents was tested and the results showed that as the amides are freely soluble in organic solvents they are nearly insoluble in aqueous medium. The results of the thermal stability of amides 1–47 at 80 °C, the chemical stability toward 3 M nitric acid, and the radiolytic stability toward γ-rays were found to be encouraging. The solubility and stability results obtained are useful for the preliminary evaluation of amides as new extracting agents.

Recently a systematic investigation of a number of amides and their application in nuclear processes was reported (*1*, *2*). Some of these amides were proposed as alternative extractants to tributyl phosphate (TBP) for separation of some actinides from lanthanides (*2*). Moreover, it was reported that the extraction properties of certain dialkylamides toward some tetra- and hexavalent ions were greatly influenced by the structure of amide (*1*, *3*). The present work covers the preparation and preliminary evaluation of different series of *N*,*N*-dialkylamides (**1**–**47**) as new extracting agents (Table I).

In general, the amides were obtained as oily compounds with good yields (62–98%), except for *N*,*N*-dicyclohexyl derivaties, where the yields ranged from 35 to 40% and the compounds were solids. The physical and spectral data are tabulated (Table II).

Solubility Behaviors. With the exception of the *N*,*N*-dicyclohexyl derivatives, the extent of the solubility of the amides in *n*-dodecance, mesitylene, chloroform, and ethanol was found to be more than 3 mol/L. On the other hand, the solubility in water was generally less than 10^{-3} g/L (Table III). From the solubility behavior point of view, the above results are considered to be encouraging.

Thermal, Chemical, and Radiolytic Stabilities. The results indicated in Table III show that the amides **1**–**47** are considered to be thermally, chemically, and radiolytically stable enough to be proposed as extracting agents for metal ions. In general, the above solubility and stability results are parallel to those reported for TBP as well as for some other amides which were recommended recently as good extractants for some actinide elements (*1*, *2*). In fact, these results fulfill some of the required features for good extractants (*4*). The results also re-

Table I. Preparation and Notation of *N*,*N*-Dialkylamides

$$RCOCl + HNR'_2 \xrightarrow{Et_3N} RCONR'_2 + Et_3NHCl$$

amide	R	R′
1	$C_6H_{11}(CH_2)_2$	*n*-Pr
2	$C_6H_{11}(CH_2)_2$	*n*-Bu
3	$C_6H_{11}(CH_2)_2$	*sec*-Bu
4	$C_6H_{11}(CH_2)_2$	C_6H_{11}
5	$C_6H_{11}(CH_2)_3$	*n*-Pr
6	$C_6H_{11}(CH_2)_3$	*i*-Pr
7	$C_6H_{11}(CH_2)_3$	*n*-Bu
8	$C_6H_{11}(CH_2)_3$	*i*-Bu
9	$C_6H_{11}(CH_2)_3$	*sec*-Bu
10	$C_6H_{11}(CH_2)_3$	*n*-Hex
11	$C_6H_{11}(CH_2)_3$	C_6H_{11}
12	$C_5H_9CH_2$	*n*-Pr
13	$C_5H_9CH_2$	*n*-Bu
14	$C_5H_9CH_2$	*sec*-Bu
15	$C_5H_9CH_2$	C_6H_{11}
16	$C_{11}H_{21}$	Et
17	$C_{11}H_{21}$	*n*-Pr
18	$C_{11}H_{21}$	*n*-Bu
19	$C_{11}H_{21}$	*sec*-Bu
20	$C_{12}H_{23}$	*n*-Bu
21	$C_{12}H_{23}$	*sec*-Bu
22	$CH_3(CH_2)_5$	*n*-Bu
23	$CH_3(CH_2)_5$	*i*-Bu
24	$CH_3(CH_2)_5$	*sec*-Bu
25	$CH_3(CH_2)_5$	*n*-Hex
26	$(CH_3)_3CCH_2$	*n*-Bu
27	$(CH_3)_3CCH_2$	*sec*-Bu
28	$(CH_3)_3CCH_2$	*n*-Hex
29	$Ph(CH_2)_2$	*n*-Pr
30	$Ph(CH_2)_2$	*n*-Bu
31	$Ph(CH_2)_2$	*sec*-Bu
32	$Ph(CH_2)_2$	C_6H_{11}
33	$Ph(CH_2)_3$	*n*-Pr
34	$Ph(CH_2)_3$	*n*-Bu
35	$Ph(CH_2)_3$	*sec*-Bu
36	$Ph(CH_2)_3$	C_6H_{11}
37	$Ph(CH_2)_4$	*n*-Pr
38	$Ph(CH_2)_4$	*n*-Bu
39	$Ph(CH_2)_4$	*sec*-Bu
40	$Ph(CH_2)_4$	C_6H_{11}
41	EtCHPh	*n*-Pr
42	EtCHPh	*n*-Bu
43	EtCHPh	*sec*-Bu
44	EtCHPh	C_6H_{11}
45	MeCHPhCH$_2$	*n*-Pr
46	MeCHPhCH$_2$	*n*-Bu
47	MeCHPhCH$_2$	*sec*-Bu

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