The desired material could not be obtained by refluxing a solution of pyrenecarboxaldehyde and aminopyridine in ethanol.

The imine was hydrogenated for 4 hr. at 2.5 atm. pressure in ethanol. Recrystallization from butanol gave a 78% yield of fine ivory-colored needles, m.p. 165–167°. Another recrystallization from ethanol afforded an analytical sample of *N*-(2-pyridyl)-1-pyrenemethylamine of the same melting point.

METHOD C. 1-Pyrenemethylamine hydrochloride. 1-Pyrenecarboxaldehyde oxime was prepared by the pyridine method[4] from 1-pyrenecarboxaldehyde and hydroxylamine hydrochloride in the presence of pyridine using ethanol as a solvent. After recrystallization from butanol a 78% yield of yellow needles was obtained. Another recrystallization from butanol afforded an analytical sample, m.p. 191.5–192.5°.

(4) R. L. Shriner, R. C. Fuson, and D. Y. Curtin, "The Sytematic Identification of Organic Compounds," Wiley, New York, 1956, p. 254.

Anal. Calcd. for $C_{17}H_{11}NO$: C, 83.24; H, 4.52; N, 5.71. Found: C, 82.89, H, 4.32; N, 6.05.

The oxime was reduced catalytically according to a method described by Hartung[5] for the preparation of benzylamine from benzaldoxime. A mixture of 2.0 g. (0.0081 mol.) of 1-pyrenecarboxaldehyde oxime, 150 ml. of ethanol containing 0.0405 mol. of hydrogen chloride, and 2.0 g. of 5% palladium on charcoal was hydrogenated at 3.4 atm. pressure at room temperature for 2 hr. The mixture was brought to boiling and filtered. The filter cake was extracted with more boiling ethanol. After removal of solvent from the combined extracts, the residual solid was dissolved in much boiling water and filtered. Addition of hydrochloric acid to the filtrate and cooling afforded 1.56 g. (72%) of a nearly white solid.

SOUTH CHARLESTON, W. VA.

(5) W. H. Hartung, U. S. Patent 1,989,093, Jan. 29, 1935.

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF NOTRE DAME]

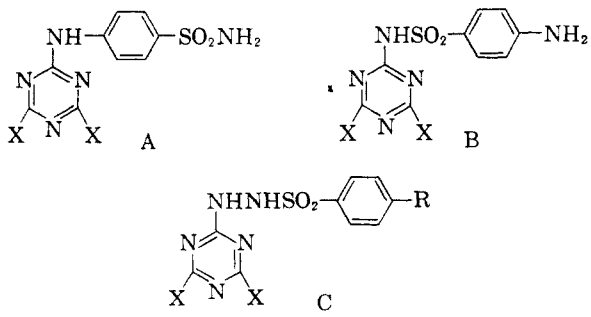
Preparation of Some Sulfonylhydrazide Derivatives of *s*-Triazine[1]

G. F. D'ALELIO AND ROBERT H. BECKER

Received August 14, 1959

Arylsulfonylhydrazides react with cyanuric chloride at 0–10° to replace one chlorine atom; these products react smoothly with secondary amines to produce 2,4-diamino-6-arylsulfonylhydrazido-*s*-triazines. A series of new compounds were prepared by the reaction sequence which is described in this paper.

The preparation of a series of N^4-sulfanilamide derivatives of *s*-triazine (A) was described in a previous paper from this laboratory.[2] It was originally planned to prepare a corresponding series of N^1-sulfanilamide derivatives (B); however all attempts in this direction failed.[3] It was then decided to substitute the sulfonylhydrazido moiety (R–SO_2-NHNH–) for the sulfonamido group (RSO_2NH–) and prepare a series of arylsulfonylhydrazide derivatives (C) to be submitted for pharmacological screening.[4]



(1) Abstracted from a portion of the Ph.D. thesis of Robert H. Becker, University of Notre Dame, 1959.

(2) G. F. D'Alelio and H. J. White, Jr., *J. Org. Chem.*, **24**, 643 (1959).

(3) H. J. White, Jr., Ph.D. Thesis, University of Notre Dame, October, 1957.

(4) Pharmacological testing is being carried out by Merck Sharp and Dohme Research Laboratories, Rahway, New Jersey.

This work shows that cyanuric chloride (III) reacts with one mole of an arylsulfonylhydrazide (II), in the presence of sodium bicarbonate, at 0–10° to form a 2,4-dichloro-6-arylsulfonylhydrazido-*s*-triazine (IV). These compounds are isolated in good yield from aqueous dioxane solution. Because of the reactivity of the remaining chlorine atoms on the triazine nucleus, it is very difficult to effect a good purification of these dichloro-*s*-triazines. However, it was found that the products as obtained from the reaction mixture and washed with water and toluene would work very well in the subsequent reactions, thus eliminating a lengthy purification which involved high loss of material.

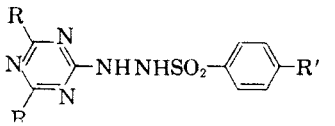
Although none of the dichloro intermediates were purified enough to obtain good analyses, they separated from the reaction mixture as dihydrates. When a sample was dried in a vacuum oven at 50° to 100° for varying periods of time, the calculated amount of weight was lost and subsequent reactions utilizing anhydrous material gave yields comparable to those utilizing the dihydrated intermediates.

The arylsulfonylhydrazides (II) used for the preparation of the dichloro-*s*-triazines were prepared from the corresponding arylsulfonyl chlorides (I) using the procedure of Curtius and Stoll[5] with slight variations.

(5) T. Curtius and W. Stoll, *J. prakt. Chem.*, 112, 117 (1926).

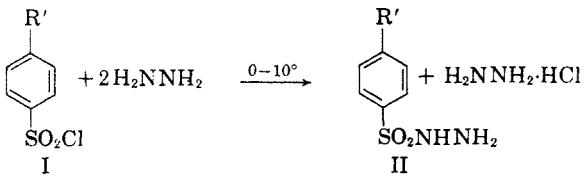
TABLE I

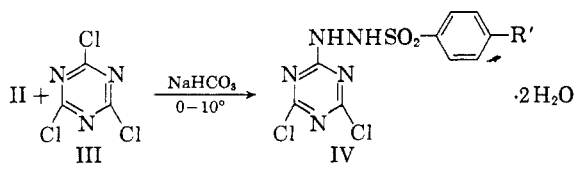
ARYLSULFONYLHYDRAZIDO-*s*-TRIAZINE



Compound	R	R′	Recryst. Solvent	M.P., °C.[a]	Yield, %
1	Cl·H_2O	H	—	161.0–163.0	64.2[b]
2	Cl·H_2O	CH_3	—	105.0–110.0	59.1[b]
3	Cl·H_2O	NHCCH$_3$ (O)	—	300.0	74.8[b]
4	$N(CH_3)_2$	H	C_2H_5OH	204.5–205.5	68.3
5	$N(CH_3)_2$	CH_3	C_2H_5OH–H_2O	163.0–165.0	48.6
6	$N(CH_3)_2$	NHCCH$_3$ (O)	C_2H_5OH–H_2O	213.0–215.0	51.3
7	$N(CH_3)_2$	NH_2	C_2H_5OH	212.5–213.5	71.5
8	$N(C_2H_5)_2$	H	C_2H_5OH–H_2O	140.0–141.0	30.3
9	$N(C_2H_5)_2$	CH_3	C_2H_5OH–H_2O	133.0–134.0	24.6
10	$N(C_2H_5)_2$	NHCCH$_3$ (O)	C_2H_5OH–H_2O	187.0–188.0	33.3
11	$N(C_2H_5)_2$	NH_2	C_2H_5OH–H_2O	157.0–159.0	24.4
12	Morpholino	H	Methyl cellosolve–H_2O	235.0–236.0	75.6
13	Morpholino	CH_3	C_2H_5OH	219.0–220.0	46.0
14	Morpholino	NHCCH$_3$ (O)	Methyl cellosolve–H_2O	252.0–253.0	66.9
15	Morpholino	NH_2	Methyl cellosolve–H_2O	239.0–240.0	56.8
16	Piperidino	H	C_2H_5OH	226.0–227.0	28.7
17	Piperidino	CH_3	C_2H_5OH–H_2O	173.0–174.0	23.2
18	Piperidino	NHCCH$_3$ (O)	C_2H_5OH–H_2O	222.0–223.0	27.4
19	Piperidino	NH_2	C_2H_5OH–H_2O	223.0–224.0	25.4
20	Pyrrolidino	H	Methyl cellosolve–H_2O	208.0–209.0	23.1
21	Pyrrolidino	CH_3	C_2H_5–H_2O	180.0–182.0	29.7
22	Pyrrolidino	NHCCH$_3$ (O)	C_2H_5OH–H_2O	214.0–215.0	33.6
23	Pyrrolidino	NH_2	C_2H_5OH–H_2O	226.0–227.0	24.7

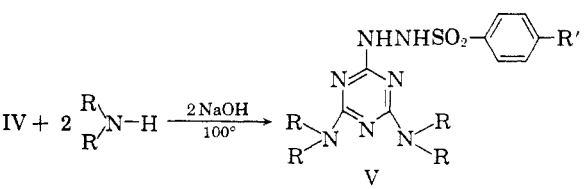
[a] All melting points were taken on a calibrated Fisher-Johns melting point apparatus. [b] Average yield.





The 2,4-dichloro-6-arylsulfonylhydrazido-*s*-triazines (IV) react with secondary amines to form 2,4-diamino-6-arylsulfonylhydrazido-*s*-triazines (V) in fair yields. The majority of these reactions ran smoothly in water at reflux temperature using aqueous sodium hydroxide as the hydrochloric acid acceptor.

When diethylamine was reacted with the dichloro-*s*-triazines in water, little or no final product was obtained. However, when toluene was used as reaction solvent and excess diethylamine as the hydrochloric acid acceptor, the desired products were formed in fair yields.



One of the sulfonylhydrazides utilized in this work was acetylsulfanilylhydrazide (II, R′ = NHCCH$_3$ (O)) which yielded a series of compounds (VI) which could be hydrolyzed to the ocrresponding free amino compounds (VII). This hydrolysis

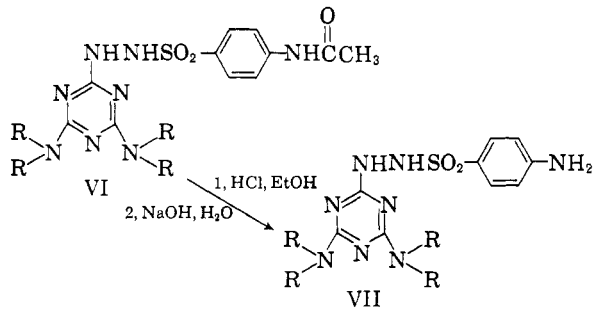
TABLE II

ANALYTICAL DATA[a]

Compound	Formula	Carbon, % Calcd.	Carbon, % Found	Hydrogen, % Calcd.	Hydrogen, % Found	Nitrogen, % Calcd.	Nitrogen, % Found
1	$C_9H_7N_5O_2SCl_2 \cdot 2H_2O$[b]	—	—	—	—	—	—
2	$C_{10}H_9N_5O_2SCl_2 \cdot 2H_2O$[c]	—	—	—	—	—	—
3	$C_{11}H_{10}N_6O_3SCl_2 \cdot 2H_2O$[d]	—	—	—	—	—	—
4	$C_{13}H_{19}N_7O_2S$	46.28	46.43	5.68	6.07	29.06	29.27
5	$C_{14}H_{21}N_7O_2S$	47.84	47.77	6.02	6.31	27.90	27.82
6	$C_{15}H_{22}N_8O_3S$	45.66	45.96	5.62	5.67	28.40	28.23
7	$C_{13}H_{20}N_8O_2S$	44.30	44.51	5.72	5.85	31.80	31.87
8	$C_{17}H_{27}N_7O_2S$	51.89	51.96	6.92	6.98	24.92	24.71
9	$C_{18}H_{29}N_7O_2S$	53.05	53.10	7.17	7.30	24.06	24.28
10	$C_{19}H_{30}N_8O_3S$	50.64	50.75	6.71	6.71	24.86	24.96
11	$C_{17}H_{28}N_8O_2S$	49.98	50.25	6.91	6.91	27.43	27.07
12	$C_{17}H_{23}N_7O_4S$	48.44	48.96	5.51	5.92	23.26	22.85
13	$C_{18}H_{25}N_7O_4S$	49.64	50.05	5.79	6.28	22.51	22.57
14	$C_{19}H_{26}N_8O_5S$	47.69	47.78	5.47	5.62	23.41	23.79
15	$C_{17}H_{24}N_8O_4S$[e]	46.78	47.01[f]	5.54	5.86[f]	25.67	24.44[g]
16	$C_{19}H_{27}N_7O_2S$	54.65	55.37	6.52	6.58	23.48	23.56
17	$C_{20}H_{29}N_7O_2S$	55.66	56.00	6.77	6.91	22.72	22.80
18	$C_{21}H_{30}N_8O_3S$	53.14	53.18	6.37	6.53	23.61	23.52
19	$C_{19}H_{28}N_8O_2S$	52.76	52.84	6.52	6.69	25.91	26.45
20	$C_{17}H_{23}N_7O_2S$	52.42	52.41	5.95	6.02	25.18	24.79
21	$C_{18}H_{25}N_7O_2S$	53.58	53.04	6.25	6.28	24.30	23.88
22	$C_{19}H_{26}N_8O_3S$	51.11	50.41	5.86	6.21	25.09	25.06
23	$C_{17}H_{24}N_8O_2S$	50.48	50.26	5.98	6.09	27.70	27.75

[a] Microanalyses were performed by Midwest Microlab, Inc., Indianapolis, Ind. [b] % H_2O: Calcd. 10.12%; found 9.50%. [c] % H_2O: Calcd. 9.73%; found 10.38%. [d] % H_2O: Calcd. 8.73%; found 8.78%. [e] Analysis shows that compound contains 5 ± 1% of methylcellosolve trapped in the crystal structure. [f] Average of three analyses. [g] Average of six analyses.

was carried out by refluxing the acetyl compounds with excess hydrochloric acid in 95% ethanol, neutralizing the resulting solution with 2*N* sodium hydroxide and precipitating the free amino compounds with water.



The arylsulfonylhydrazide derivatives of *s*-triazine prepared in this work are described in Table I and the analytical data are given in Table II.

EXPERIMENTAL

Preparation of arylsulfonylhydrazides. A solution of 1 mol. (100 g.) of hydrazine (64% aqueous) in an equal volume (100 ml.) of water or ethanol was prepared in a 1-l. three-necked flask equipped with agitation and thermometer and cooled to 0–10° in an ice bath. A 0.5-mol. sample of the arylsulfonyl chloride was added in small portions over a period of 1.5 hr., and the reaction mixture was agitated for an additional 1.5 hr. at ice bath temperature. More water or ethanol was added as needed during the addition, to allow complete mixing and to prevent caking of the solids. The crude product was collected by filtration, washed with water and toluene, and dried in a vacuum desiccator. The yields averaged 70–90%. Further purification could be accomplished by dissolving the crude product in boiling water (3–4 l.), filtering, and cooling the solution immediately. However, this lowered the yields and was unnecessary for the purpose of this work.

Preparation of 2,4-dichloro-6-arylsulfonylhydrazido-s-triazines. Cyanuric chloride (9.2 g., 0.05 mol.) and sodium bicarbonate (4.1 g., 0.05 mol.) were slurried in 100 ml. of a dioxane:water mixture in a 250-ml. three-necked flask equipped with agitation and thermometer and cooled to 0–10° in an ice bath. The arylsulfonyl hydrazide (0.05 mol.) was added in small portions over a period of 0.5 hr. and the reaction mixture was agitated for an additional 1 hr. at ice bath temperature and poured into 400 ml. of ice water. The product in some cases separated as a gummy semisolid which solidified on standing. This was collected by filtration, washed with water and toluene, and dried in a vacuum desiccator.

Preparation of 2,4-diamino-6-arylsulfonylhydrazido-s-triazines. A slurry of the 2,4-dichloro-6-arylsulfonylhydrazido-*s*-triazine (0.01 mol.) in 100 ml. of water was prepared in a 300-ml. three-neck flask equipped with agitation, reflux condenser, and dropping funnel. A solution of the desired amine (0.02 mol.) in 25 ml. of water was added over a period of 15 min. and the reaction mixture was heated to reflux. A few drops of phenolphthalein were added and 10 ml. of 2*N* sodium hydroxide (0.02 mol.) was added over a period of 15 to 30 min. at such a rate that the solution was always neutral or just slightly basic. The reaction mixture was refluxed for 2 to 3 hr., cooled, and filtered. The crude product was washed with water, recrystallized from the appropriate solvent, after clarification with activated charcoal, (Norit A or Darco G) and dried in a vacuum oven at 100° for 12 to 24 hr.

Preparation of 2,4-bis(diethylamino)-6-arylsulfonylhydrazido-s-triazines. A slurry of 2,4-dichloro-6-arylsulfonylhydrazido-*s*-triazine (0.01 mol.) in 75 ml. of toluene was prepared in a 300-ml. three-neck flask equipped with agitation, reflux condenser, and dropping funnel, and heated to reflux. A solution of diethylamine (3.1 g., 0.04 mol.) in 50

ml. of toluene was added over a period of 2 hr. and the reaction mixture was refluxed for an additional 5 hr. The hot toluene solution was decanted to a beaker, evaporated to one-fourth volume by a stream of air, and filtered. This solid was combined with any residue in the reaction flask, recrystallized from the appropriate solvent, after clarification with activated charcoal (Norit A or Darco G), and dried in a vacuum oven at 100° for 12 to 24 hr.

Preparation of 2,4-diamino-6-sulfanilylhydrazido-s-triazines from 2,4-diamino-6-acetylsulfanilylhydrazido-s-triazines. The 2,4-diamino-6-acetylsulfanilylhydrazido-s-triazine (0.01 mol.) was dissolved in 30 ml. of ethanol, to which 5 ml. of concentrated hydrochloric acid (0.05 mol.) had been added, in a 100-ml. flask equipped with a reflux condenser. The solution was refluxed on a steam bath for 1 to 2 hr., cooled, and made basic to phenolphthalein with 2*N* sodium hydroxide. The crude product was precipitated by flooding the solution with 300 ml. of water and was collected by filtration, washed with water, and recrystallized from the appropriate solvent, after clarification with activated charcoal (Norit A or Darco G), and dried in a vacuum oven at 100° for 12 to 24 hr.

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[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, THE OHIO STATE UNIVERSITY]

Preparation of 2,4-Dinitrophenylhydrazine Derivatives of Highly Oxygenated Carbonyl Compounds

M. L. WOLFROM AND G. P. ARSENAULT[1]

Received October 14, 1959

The reaction of α-hydroxycarbonyl compounds with 2,4-dinitrophenylhydrazine in boiling aqueous ethanol (90%) or in 2*N* hydrochloric acid (supersaturated with the reagent) at 0° has been shown to proceed to hydrazone formation without oxidation of the hydroxyl group. Chromatographic purification of reaction products demonstrated that other experimental conditions can lead to osazone formation accompanied by reduction of the terminal hydroxymethyl group to methyl. The reaction of triose reductone with 2,4-dinitrophenylhydrazine has been shown to proceed with oxidation. The 1,2-bis(2,4-dinitrophenylhydrazone) of mesoxaldehyde has been synthesized by a definitive method and converted to the tris derivative. The absorption spectrum of mesoxaldehyde 1,2-bis(2,4-dinitrophenylhydrazone) was markedly affected by the solvent medium. An explanation for this behavior is proposed.

In connection with the ignition decomposition of cellulose nitrate,[2] we became interested in 2,4-dinitrophenylhydrazine derivatives of short carbon chain (two and three carbon atoms) sugars and nonfragmented oxidation products thereof. These derivatives, and in some cases the parent carbonyl compounds as well, were little or not known. In addition, when literature was available on these 2,4-dinitrophenylhydrazine derivatives, it was often contradictory. The reactivity of α-hydroxycarbonyl compounds toward 2,4-dinitrophenylhydrazine is a case in point since some workers[3,4] have reported the sole formation of 2,4-dinitrophenylosazones whereas other workers[5–7] have been able to prepare the 2,4-dinitrophenylhydrazones. In the work herein reported, the reaction of glycolaldehyde, acetol (CH_3—CO—CH_2OH), dihydroxyacetone, and DL-glycerose (glyceraldehyde) with 2,4-dinitrophenylhydrazine in boiling ethanol, a method of preparing 2,4-dinitrophenylhydrazine derivatives introduced by Brady and Elsmie[8] and used by Reich and Samuels[7] to prepare the 2,4-dinitrophenylhydrazones of α-hydroxycarbonyl compounds, was shown to proceed without oxidation and, in the case of dihydroxyacetone and DL-glycerose, without hydroxymethyl group reduction[9] as well. These facts were established by isolative column chromatography[10] of the reaction products. By means of the same chromatographic method, it was shown that the use of a supersaturated solution of 2,4-dinitrophenylhydrazine in 2*N* hydrochloric acid at 0°, a reagent solution used by Collatz and Neuberg[5] to prepare glycolaldehyde 2,4-dinitrophenylhydrazone, to form a derivative of DL-glycerose resulted in no oxidation or reduction.[9]

Since dihydroxyacetone and glycerose are known to be converted to methylglyoxal in the presence of

(1) Fellow of The Monsanto Chemical Co. (1956–57).

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