Notes

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Reaction of Biguanides and Related Compounds. X.[1] Formation of s-Triazinethiones by the Condensation of Arylbiguanides with 2,3-Trithiocarbonates

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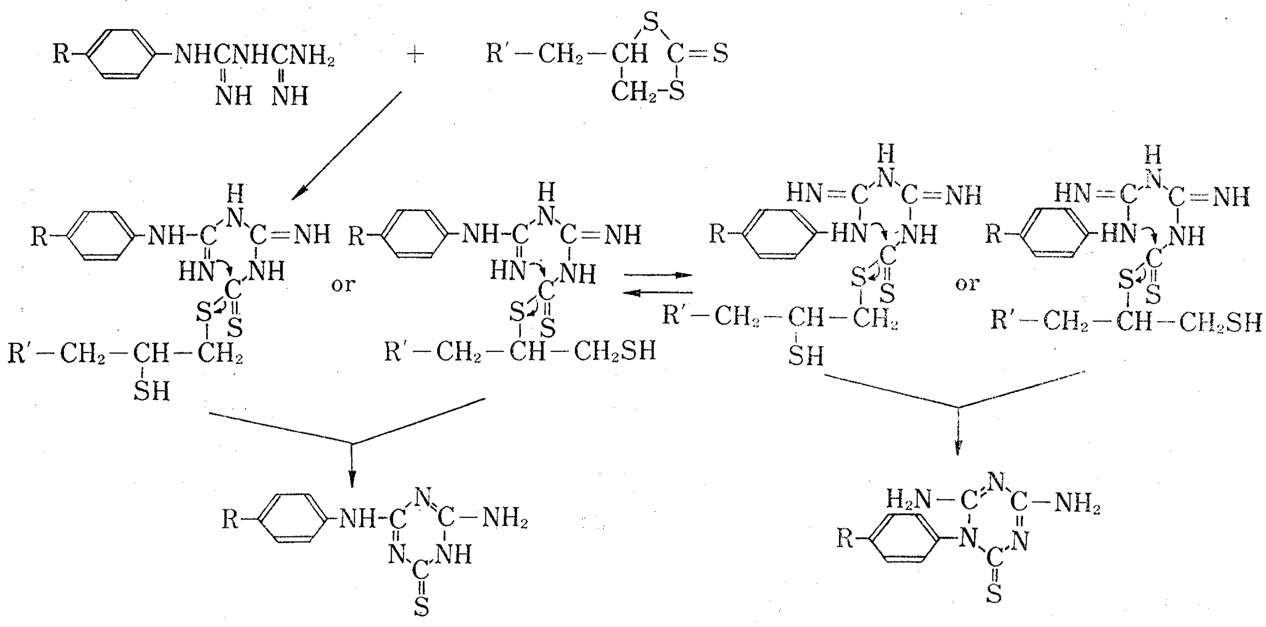
A number of *s*-triazines have hitherto been prepared by the reaction of biguanides with carbonyl compounds. Recently, Goerdeler[3,4] has reported that *s*-triazinethiones were synthesized by the reactions of amidines, isoureas, isothioureas and guanidines with aroylisothiocyanates,[3a] ethoxycarbonylthiocyanates[3b] and imidoylisothiocyanates.[4] As a novel synthetic method of *s*-triazinethiones, we attempted to carry out the reaction of arylbiguanides with 2,3-trithiocarbonates.

When arylbiguanides, such as phenyl, *p*-tolyl and *p*-chlorophenylbiguanide, were heated with an equivalent amount of 1-morpholinopropylene-2,3-trithiocarbonate[5] in ethanol for five hours under reflux, the products were obtained in about 25% yields. The same reaction in a small amount of dimethylformamide (DMF) under heating at 100° for three hours gave



I R=H, CH_3, Cl

II R=CH_3O, C_2H_5O

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[1] Part IX: M. Furukawa, K. Matsuoka, Y. Kojima and S. Hayashi, *Chem. Pharm. Bull.* (Tokyo), 22, 1, (1974).

[2] Location: *Oe-hon-machi, Kumamoto.*

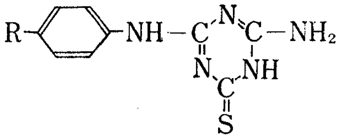
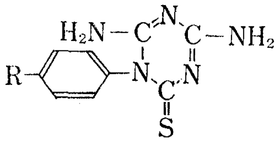
[3] *a*) J. Goerdler and J. Neuffer, *Chem. Ber.*, **104**, 1580 (1971); *b*) *Idem, ibid.*, **104**, 1606 (1971).

[4] J. Neuffer and J. Goerdeler, *Chem. Ber.*, **104**, 3498 (1971).

[5] *a*) S. Hayashi, M. Furukawa, Y. Fujino, T. Nakao and K. Nagato, *Chem. Pharm. Bull.* (Tokyo), **19**, 1594 (1971); *b*) R.F. Homer, *J. Chem. Soc.*, **1950**, 3696.

the same product in purer states and in better yields. The same products were also obtained in lower yields by heating the arylbiguanides with 1-(β-naphthoxy)propylene-2,3-trithiocarbonate[4] in ethanol or DMF under the similar conditions. On the other hand, when the equivalent amounts of *p*-alkoxyphenylbiguanides and 1-morpholinopropylene-2,3-trithiocarbonate were heated in ethanol or DMF under the similar conditions, quite different another products were obtained. It should be noted that such a difference of reactivity is attributed to the group substituted in benzene ring. By considering the behaviors[5,6] of 2,3-trithiocarbonates toward amines and the experimental elementary analyses and the spectral data of the products, the reaction would proceed through the following mechanistic pathways, which are possible to produce two isomeric products (I, II). In fact the analogous pathway[7] is known in the reaction of phenylbiguanide with phenylisothiocyanate. The structures of these two possible compounds (I, II) were distinguished by the infrared (IR) spectra. Evidence for these structures was provided on the basis of the following facts: i) good agreement of the elemental analytical data with the calculated values; ii) the existence of strong molecular ion peaks in the mass spectra; iii) the IR spectra of I exhibited absorptions assignable to a primary amino group at near 3450 cm^{-1}, due to a secondary amino group at near 3300 cm^{-1} and 3220 cm^{-1} and attributed to a thiocarbonyl group at near 1180 cm^{-1}. II exhibited IR absorptions assignable to a primary amino group at near 3420 cm^{-1} and due to a thiocarbonyl group at near 1165 cm^{-1}, but not absorption attributed to a secondary amino group. By these results, it is presumed that the products obtained from arylbiguanide in which hydrogen, methyl and chloro groups were involved in the para position of benzene ring

Table I. 2-Amino-4-arylamino-1,6-dihydro-*s*-triazine-6-thione and 2,4-Diamino-1-aryl-1,2-dihydro-*s*-triazine-6-thione

R	mp (°C)	Yield (%) in EtOH	Yield (%) in DMF	Formula	Analysis (%) Calcd. (Found) C	H	N	IR ν_{max}^{KBr} cm^{-1} NH$_2$	NH	C=S
										
H	282	26	34	$C_9H_9N_5S$	49.31 (49.57)	4.14 (4.49)	31.95 (31.59)	3458	3322 3220	1180
CH$_3$	285	21	34	$C_{10}H_{11}N_5S$	51.49 (51.73)	4.75 (4.70)	30.03 (29.95)	3462	3302 3220	1180
Cl	287	23	28	$C_9H_8N_5SCl$	42.69 (42.93)	3.38 (2.93)	27.45 (27.37)	3450	3302 3235	1185
										
CH$_3$O	290	28	34	$C_{10}H_{11}ON_5S$	48.19 (48.18)	4.45 (4.37)	28.10 (28.08)	3420		1163
C$_2$H$_5$O	288	16	27	$C_{11}H_{13}ON_5S$	50.18 (50.25)	4.98 (5.04)	26.61 (26.30)	3420		1169

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6) R. Delaby, P. Piganiol and C. Warolin, *Compt. Rend.*, **230**, 1671 (1950) [*C.A.*, **44**, 8870^b (1950)].

7) M. Furukawa, K. Nagato, Y. Kojima and S. Hayashi, *Chem. Pharm. Bull.* (Tokyo), **20**, 1824 (1972); L. Somogyi, Z. Gyorgydeak and R. Bognar, *Chem. Ber.*, **100**, 1975 (1967).

would be 2-amino-4-arylamino-1,6-dihydro-*s*-triazine-6-thione and the products derived from *p*-alkoxyphenylbiguanide would be 2,4-diamino-1-aryl-1,6-dihydro-*s*-triazine-6-thione. It is assumed that the different behavior of *p*-alkoxyphenylbiguanide is attributed to the increased nucleophilic property of the N^1 atom in which the electron density is increased by the resonance of the electron pair of the oxygen atom of the *p*-alkoxy group with benzene ring. Extensions and developments of this work are in progress.

Experimental

2-Amino-4-arylamino-1,6-dihydro-*s*-triazine-6-thione (I)——1) A solution of 0.002 mole of arylbiguanide and 0.002 mole of 1-morpholinopropylene-2,3-trithiocarbonate in 30 ml of EtOH was heated for 5 hr under reflux. Precipitates deposited gradually from the reaction mixture during heating. After cooling, the precipitates deposited were collected by filtration and recrystallized from DMF. When the both reactants were heated in 1.5 ml of DMF for 3 hr at 100° and then treated by the similar procedure, the yield of the products was somewhat increased. Details of the data were summarized in Table I. These compounds exhibited the abundant corresponding molecular ion peaks in the mass spectra.

2) A solution of 0.002 mole of phenylbiguanide and 0.002 mole of 1-(β-naphthoxy)propylene-2,3-trithiocarbonate in 30 ml of EtOH was heated for 5 hr under reflux. Precipitates gradually deposited from the reaction mixture during heating. After cooling, the precipitates deposited were collected by filtration and recrystallized from DMF to give 0.05 g (11%) of colorless prisms melting at 282°, which was identified with the sample prepared by the procedure described above by mixed melting point determination and infrared comparison. Treatment of another arylbiguanide with 1-(β-naphthoxy)propylene-2,3-trithiocarbonate under the similar conditions gave the corresponding *s*-triazinethiones in low yields.

2,4-Diamino-1-(*p*-alkoxyphenyl)-1,6-dihydro-*s*-triazine-6-thione (II)——A solution of 0.002 mole of *p*-alkoxyphenylbiguanide and 0.002 mole of 1-morpholinopropylene-2,3-trithiocarbonate in 30 ml of EtOH or in 1.5 ml of DMF was heated for 3—5 hr at 100°. Precipitates gradually deposited from the reaction mixture during heating. After cooling, the precipitates deposited were collected by filtration and recrystallized from DMF. Details of the data were summarized in Table I.

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Formic Acid Reduction. XX.[1] Reduction of 2-Benzylidene-1,3-indandiones

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The formic acid reduction of the carbon–carbon double bonds adjacent to carbonyl discovered from this laboratory[3] appears a reaction of considerable synthetic significance. The present work has been directed toward the formic acid reduction of 2-benzylidene-1,3-indandiones possessing substituent on the benzylidene ring.

For preparation of the 2-benzylidene-1,3-indandiones by condensing 1,3-indandione and benzaldehydes, we adopted the previously reported method[4] using boron trioxide as a

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[1] Part XIX: M. Sekiya, M. Tomie, K. Ito, J. Suzuki, K. Suzuki, and Y. Terao, *Chem. Pharm. Bull.* (Tokyo), 21, 1625 (1973).

[2] Location: *2-2-1, Oshika, Shizuoka.*

[3] M. Sekiya and K. Suzuki, *Chem. Pharm. Bull.* (Tokyo), **18**, 1530 (1970).