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Some Addition Reactions of 3-Arylidene-5,6-diphenyl-1,2,4-triazenes

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Addition of various functional compounds such as butane-1-thiol, 2-methyl-1,3-butadiene, thioglycolic acid, chloroacetyl chloride, sodium ethylate, thiosalicyclic acid, p-chlorothiophenol and also the reduction with zinc-acetic acid to 3-arylidene-5,6-diphenyl-1,2,4-triazenes (IIa-d) have been studied. The structural assignments of all the new products were based on elemental analysis, characteristic IR and PMR data.

INTRODUCTION

In a previous work of the authors[1,2], it has been found that Grignard reagents add to 1,2,4-triazene derivatives to give the additional products, where the addition has occurred across the 4,5 N=C linkage of the 1,2,4-triazene moiety. This prompted us to investigate the behaviour of 3-arylidene-5,6-diphenyl-1,2,4-triazines (IIa-d) toward the addition of some functional compounds.

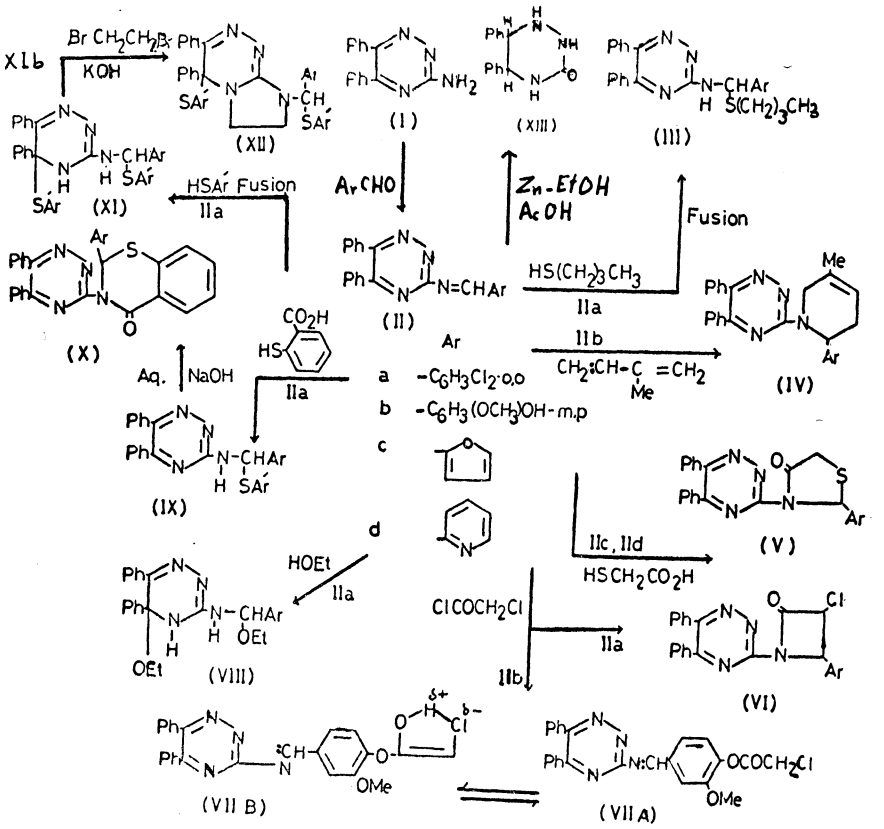
RESULTS AND DISCUSSION

By fusion of (IIa) with butane-1-thiol at 140–150°C, thioether of the type (III) was isolated, while refluxing (IIb) with 2-methyl-1,3-butadiene in the presence of dry toluene gave 1-(5′,6′-diphenyl-1′,2′,4′-triazin-3′-yl)-2-aryl-5-methyl-3,6-tetrahydropyridine(IV) through the diene-dienophile-1,3-cycloaddition[3,4]. Addition of thioglycolic acid[5,6] to the arylidene (IIc) and (IId) and further condensation furnished the 2,3-disubstituted-4-thiazolidinone (Va,b). The ring closure step initially involves attack of the lone pair of the –N̈H– on the β-carbon of the thio side chain, with loss of one mole of the water.

Investigation of the addition of chloroacetyl chloride to 3-arylidene-5,6-diphenyl-1,2,4-triazines (II) indicated that the course of this reaction is governed by the medium and reaction conditions. Thus, cycloaddition of chloroacetyl chloride with 3-arylidene-5,6-diphenyl-1,2,4-triazine (IIa) was carried out in dry benzene-triethylamine as an acid binding agent to give the corresponding lactam (VI). On the other hand, refluxing of (IIb) with chloroacetyl chloride in the presence of aq. bicarbonate[8] gave 3-methoxy-4-chloroacetoxy-benzylidene derivative (VII).

Reactions of (VII) with guanidine or semicarbazide in basic medium having failed, we have suggested both polar and single electron transfer mechanisms for the reaction between carbonyl group and chloride ion in the chloroacetoxy side chains, which caused the greater tendency to form (VIIB) in the basic medium.

The addition of sodium ethylate[9] on (IIa) is possible and results in the additional product (VIII). Formation of the latter indicates the greater polarity of the nucleophile and gives the possibility of the addition on exo N=C in the position 3 and on endo N=C in 4,5-position in the 1,2,4-triazine moiety.



Scheme 1

Zaher *et al*[10], observed that fusion of 3-(N-arylidene hydrazone)-1,2,4-triazene derivatives with thiophenol gives the addition on the 3-hydrazone and 4,5 N=C linkage of the 1,2,4-triazine nucleus. Thus, refluxing (IIa) with thiosalicylic acid in dry toluene yielded the desired thioether derivative (IX). Structure of IX was established on the basis of analytical data, IR spectra and formation of 2-aryl-3-(5′,6′-diphenyl-1′,2′,4′-triazin-3′-yl)-1,3-benzothiazin-4(2H) -one(X) by refluxing with aq. NaOH, while fusion of (IIa) with thiosalicylic acid and *p*-chlorothiophenol gave the thioether (XIa,b). Moreover, treatment of (XIb) with 1,2-dibromoethane in ethanolic KOH led to the direct formation of 1-substituted-methyl-4,5-tetrahydro-imidazolo-[2,3-c] [1,3,4]-triazine derivative (XII).

Finally, reduction of (IIa) and/or (IIb) with Zn–AcOH in the presence of ethanol gave the unexpected hexahydro-5,6-diphenyl-1,2,4-triazin-3-one (XIII)[11]. The structure of the latter was based on the analytical and spectral data, furthermore, compound (XIII) was found to be identical with the product obtained by reduction of 3-chloro-1,2,4-triazine derivative[3]. Conversion of (II) into (XIII) is believed to occur most probably through a strong nucleophilic displacement of the arylidene group of (II) with carbonyl group in the reduced form (XIII). The probable mechanism for this type of reaction may involve the full hydrogenation reduction followed by addition of one mole of water via position-3; the 1,2,4-triazine, finally, repaling the N-acetylamino derivative intermediate [Chart 1].

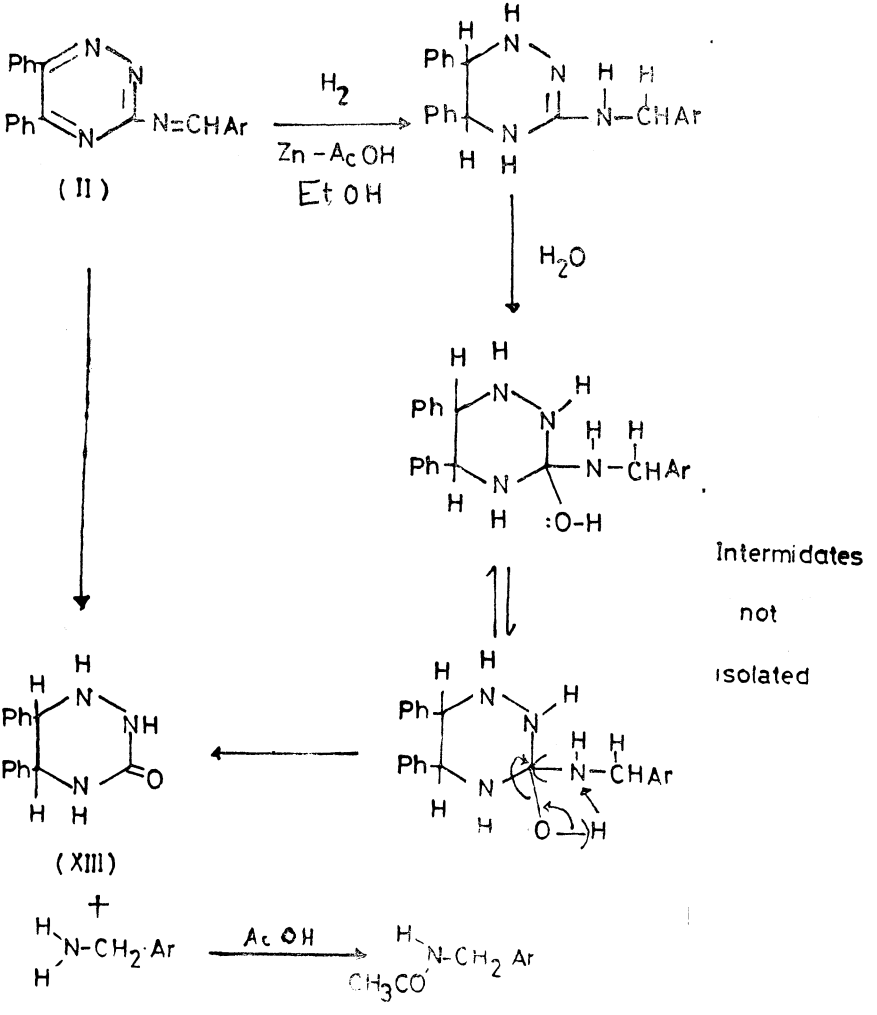


Chart I

EXPERIMENTAL

M.pts. are uncorrected. IR spectra are recorded (KBr) with a Pey Unicam SP 1100 spectrophotometer (ν cm^{-1}). H^1 NMR spectra are obtained on a Varian EM 390 90 MHz spectrometer in DMSO-d_6 using TMS as internal indicator and chemical shifts are expressed as δ ppm. The 3-amino-5,6-diphenyl-1,2,4-triazine(I) was prepared by reported method[12].

3-Arylidene-5,6-Diphenyl-1,2,4-Triazene: General Procedure

An equimolecular amount of (I) and the properly substituted aldehydes in glacial acetic acid (50 ml) was refluxed for 1 hr, left to cool and the solid so formed was filtered off and recrystallized from acetic acid to give (IIa–d) (Table 1); IR of (IIb): 3455 (OH), 3050 (aromatic CH), 2850 (aliphatic CH), 1600 (acyclic C=N), 1565 (cyclic C=N), 1450 (CH_3 def.), 1030 (R–O–Ar ether) and 900, 850 (phenyl group). PMR of (IIb): 2.5 (s, *3H*, CH_3), 3.3 (s, *1H*, –CH=N–), 6.9 (m, *3H*, C_6H_3) and 7.4–7.6 (m, *10H*, phenyl proton of 1,2,4-triazine).

Fusion of (IIa) with Butan-1-Thiol: Formation of (III)

A mixture of each (IIa) and butane-1-thiol (0.01 mol) was heated in an oil-bath at 150–160°C for 2 hrs. The mixture was allowed to cool, then treated with pet. ether at 40–60°C, and the solid so formed was collected by filtration and crystallized to give (III) (Table 1).

Cycloaddition of (IIb): Formation of (IV)

A mixture of each of (IIb) and 2-methyl-butadiene (0.01 mol) in dry toluene (100 ml) was refluxed for 12 hrs. The reaction mixture was allowed to cool and the solid so formed was filtered off and crystallized to give (IV) (Table 1); IR : 3450 (OH), 3020 (aromatic CH), 2945, 2865 (aliphatic CH), 2600 (OH bending), 1640 (C=N cyclic of pyridine), 1600 (C=N cyclic), 1480–1440 (CH_2 def.), 1050 (R–O–Ar) and 950, 850 (phenyl group). PMR : 2.6 (s, *6H*, CH_3 and OCH_3), 3.2 (s, *4H*, CH_2–CH_2), 3.4 (s, *1H*, CH=CH), 7.1 (m, *3H*, C_6H_3), 7.3–7.5 (m, *10H*, 2 phenyl) and 8 (s, *1H*, OH, phenol).

Action of Mercaptoacetic Acid on (IIc,d): Formation of (Va) and (Vb)

A mixture of (IIc) and/or (IId) (0.01 mol) and mercaptoacetic acid (0.01 mol) in dry benzene (100 ml) was refluxed for 1 hr, then added fused Na_2SO_4 (100 g) and refluxed for 5 hrs. The reaction mixture was filtered while hot and concentrated. The solid precipitated after cooling was recrystallized to give (Va) and (Vb) (Table 1); IR of (Vb) : 3020 (aromatic CH), 2900–2800 (aliphatic CH), 1750–1650 (C=O), 1480, 1450 (CH_2 def.), 1350 (CNS), 1200–1180 (C–S) and 1000, 900, 840 (phenyl group).

TABLE 1
ANALYTICAL AND PHYSICAL DATA OF
THE PRODUCTS (II–XIII)

Compound No.	Crystallized from	M.pt. (°C)	Yield (%)	Mol. formula*	Analysis Found/(Calc)% S	Cl
IIa	AcOH	140	85	$C_{22}H_{14}N_4Cl_2$	—	17.0 (17.5)
IIb	AcOH	160	80	$C_{23}H_8N_4O_2$	—	—
IIc	EtOH	165	60	$C_{20}H_{14}N_4O$	—	—
IId	EtOH	180	75	$C_{21}H_{15}N_5$	—	—
III	C_6H_6	160	60	$C_{26}H_{24}N_4SCl_2$	6.2 (6.5)	13.9 (14.3)
IV	$C_6H_5CH_3$	280	65	$C_{28}H_{26}N_4O_2$	—	—
Va	C_6H_6	180	70	$C_{22}H_{16}N_4SO_2$	7.5 (8.0)	—
Vb	Pet. ether	260	60	$C_{23}H_{17}N_5SO$	7.5 (7.8)	—
VI	DMF	210	70	$C_{24}H_{15}N_4Cl_3O$	—	21.9 (22.2)
VII	DMF	240	75	$C_{25}H_{19}N_4ClO_3$	—	7.7 (7.8)
VIII	EtOH	190	80	$C_{26}H_{26}N_4Cl_2O_2$	—	14.0 (14.3)
IX	C_6H_6	160	80	$C_{29}H_{20}N_4SCl_2O_2$	5.5 (5.7)	12.4 (12.7)
X	Pet. ether	250	80	$C_{29}H_{18}N_4SCl_2O$	5.5 (5.9)	13.0 (13.1)
XIa	Pet. ether	260	65	$C_{34}H_{26}N_4S_2Cl_2$	10.0 (10.2)	11.2 (11.4)
XIb	Pet. ether	200	65	$C_{34}H_{24}N_4S_2Cl_4$	8.7 (9.2)	20.0 (20.2)
XII	EtOH	240	68	$C_{36}H_{26}N_4S_2Cl_4$	8.5 (8.9)	19.2 (19.7)
XIII	AcOH	242	90	$C_{15}H_{15}N_3O$	—	—

*All the compounds gave satisfactory C, H and N analysis.

Synthesis of β-Lactam Derivative (VI)

To a well stirred solution of (IIa) (0.01 mol) and triethylamine (0.01 mol) in dry benzene, an equimolecular amount of chloroacetyl chloride was added dropwise at room temperature. The mixture was then stirred for 8 hrs, and left standing for 3 days. The precipitated triethylamine hydrochloride was filtered off and washed with dry benzene. The combined filtrate was washed with dil. HCl, then with water and dried over magnesium sulphate. After filtration the solvent was evaporated and the residue which solidifies with ether was crystallized to give (VI) (Table 1); IR of (VIa): 3020 (aromatic CH), 2800 (aliphatic CH), 1650 (C=O), 1460 (CH_2 def.), 1010, 920 (phenyl group) and 685 (C-Cl). PMR of (VIa): 2.6 (s, *1H*, -CH-Ar), 3.4 (s, *1H*, -CH-Cl), 6.9 (m, *3H*, $C_6H_3Cl_2$), and 7.2-7.5 (m, *10H*, phenyl protons).

Substituted 1,2,4-Triazino-(3-Methoxy-4-Chloroacetoxy)-Benzilidene (VII)

This compound was prepared by the method of Tiwari *et al.*[5] IR-3450-3350 (OH) 3020 (aromatic CH) 2900 (aliphatic CH) 2650 (OH bending), 2300 ($\overset{\delta-}{O}\text{-}\overset{+}{H}\cdots\overset{\delta-}{Cl}\text{-CH}$), 1685-1650 (C=O), 1600 (C=N), 1570 (—C(CH)=CH), 1450 (CH_2 def.), 1050 (Ar-O-CH_3), 950, 900 (phenyl group) and 675 (C-Cl).

Reaction of (IIa) with Sodium Ethylate: Formation of (VIII)

A mixture of (IIa) (0.01 mol), sodium ethylate (0.015 mol) and abs. ethanol (25 ml) was heated under reflux for 12 hrs. The solvent was removed. The residue obtained was added with stirring to an ice-cold water containing conc. HCl. Finally the solid was crystallized to give (VIII) (Table 1); IR : 3385-3280 (NH, NH), 3020 (aromatic CH), 2800 (aliphatic CH), 1450 (CH_2 def.), 1040 (R-O-Ar), 950, 860 (phenyl group).

Addition of Thiosalicyclic Acid to (IIa) : Formation of (IX)

An equimolecular mixture of (IIa) and thiosalicyclic acid in dry toluene was refluxed for 8 hrs. The solid obtained after cooling was refluxed and crystallized to give (IX) (Table 1) IR: 3420 (OH), 3250 (NH), 3050 (aromatic CH), 2850 (aliphatic CH), 1650-1630 (C=O), 1465 (CH def.), 1380 (NCS), 1130 (C-S) and 1000, 850 (phenyl group)[13].

Cyclization of (IX): Formation of (X)

To (IX) (2 g) aq. solution of NaOH (10%, 100 ml) was added. The reaction mixture was refluxed for 2 hrs., cooled, neutralized with dil. HCl and the precipitated solid was recrystallized to give (X) (Table 1).

Action of Thiosalicyclic Acid and p-Chlorothiophenol on (IIa): Formation of (XIa, b)

A mixture of (IIa) (0.01 mol) and excess thiosalicylic acid or *p*-chlorothiophenol (0.02 mol) was heated at 140–150°C (oil-bath) for 6 hrs. The solid obtained was triturated with pet. ether at 40–60°C to give (XIa) and (XIb) (Table 1); IR of (XIb): 3345–3250 (NH, NH), 3020 (aromatic CH), 2900 (aliphatic CH), 1450 (CH def.), 1375 (NCS), 1100 (C–S), 1000 and 850 (phenyl group)[13,14]. PMR of (XIb): 3.4 (s, *1H*, N-CH-S), 7.2–8 (m, *21H*, phenyl and aryl protons) and 8.9 (s, *2H*, NH).

Reaction of (XIb) with 1,2-Dibromethane: Formation of (XII)

To a suspension of (XIb) (0.01 mol) in ethanolic KOH (10%, 100 ml), 1,2-dibromethane (0.01 mol) was added. The reaction mixture was refluxed for 4 hrs. It was cooled, diluted with cold water and chilled in ice. The resulting solid was filtered, dried and crystallized to give (XII) (Table 1); IR: 3010 (aromatic CH), 2850 (aliphatic CH), 1480 (CH_2 def.), 1090 (C–S) and 1000, 900 (phenyl group). PMR: 2.5 (s, *2H*, CH_2), 3.2 (s, *2H*, CH_2), 3.8 (s, *1H*, NCH SAr) and 7–7.8 (m, *21H*, phenyl and aryl proton).

Reduction of (IIa): Formation of (XIII)

A mixture of (IIa) (2 g) and zinc dust (5 g) in ethanol (50 ml) and acetic acid (50 ml) was heated under reflux for one and/or 2 hrs., filtered while hot and concentrated. The solid obtained was recrystallized to give (XIII)[11], m.p. and m.m.pt. 240–42°C.

REFERENCES

1. H. A. Zaher, Y. A. Ibrahim, O. Sharif and R. Mohammady, *Indian J. Chem.*, **22B**, 559 (1985).
2. E. A. Zaher, Y. A. Ibrahim and R. Mohammady, *J. Heterocyclic Chem.*, **21**, 905 (1984).
3. R. M. Abdel-Rahman, *Indian J. Chem.*, **25B**, 815 (1986).
4. A. R. Katritzky and N. Dennis, *Chem. Rev.*, **89**, 827 (1989).
5. R. M. Abdel-Rahman, *Pak. J. Sci. and Ind. Res.*, **30**, 490 (1987).
6. ———, *Pak. J. Sci. and Ind. Res.*, **32**, 240 (1989).
7. A. K. El Shafei and Abdel-Ghany, *J. Indian Chem. Soc.*, **61**, 62 (1984).
8. S. S. Tewari, M. I. Husain and G. C. Srivastava, *J. Indian Chem. Soc.*, **58**, 214 (1981).
9. R. Asbjoern, R. Frode and U. Kjell, *Chem. Abstr.*, **103**, 719, 141919 (1985).

10. H. A. Zaher, H. Jahine, O. Sherif and R. Mohammady, *Indian J. Chem.*, **18B**, 316 (1979).

11. M. Polonovski, M. Pesson and P. Cr habd Rajzman, *Sci. Acad. Sci.* (*Paris*), **238**, 1134 (1954).

12. K. Miura, M. Ikeda, T. Oohashi, K. Ichamura, Y. Igarashi and E. Hasegawa, *Yakugaku Zasshi*, **81**, 1357 (1961).

13. R. M. Abdel-Rahman, *Il Farmaco*, **46**, 379 (1991).

14. R. M. Abdel-Rahman and M. S. Abdel-Malik, *Pak. J. Sci. and Ind. Res.* (in press).

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