# BRIDGEHEAD NITROGEN HETEROCYCLES. PART V[#]. SYNTHESIS OF SOME 1,3,4-OXA/THIADIAZOLO(3,2-a)PYRIMIDIN-5-ONES, 1,3,4-OXA/THIADIAZOLO(3,2-a)(1,3,5)TRIAZIN-7-THIONES, 1,3,4-THIADIAZOLO(3,2-a)(1,3,5)TRIAZINE-5(6H,7H)- THIONES, 1,2,4-TRIAZOLO(3,4-b)(1,3,4)THIADIAZINE AND THIADIAZOLES DERIVATIVES

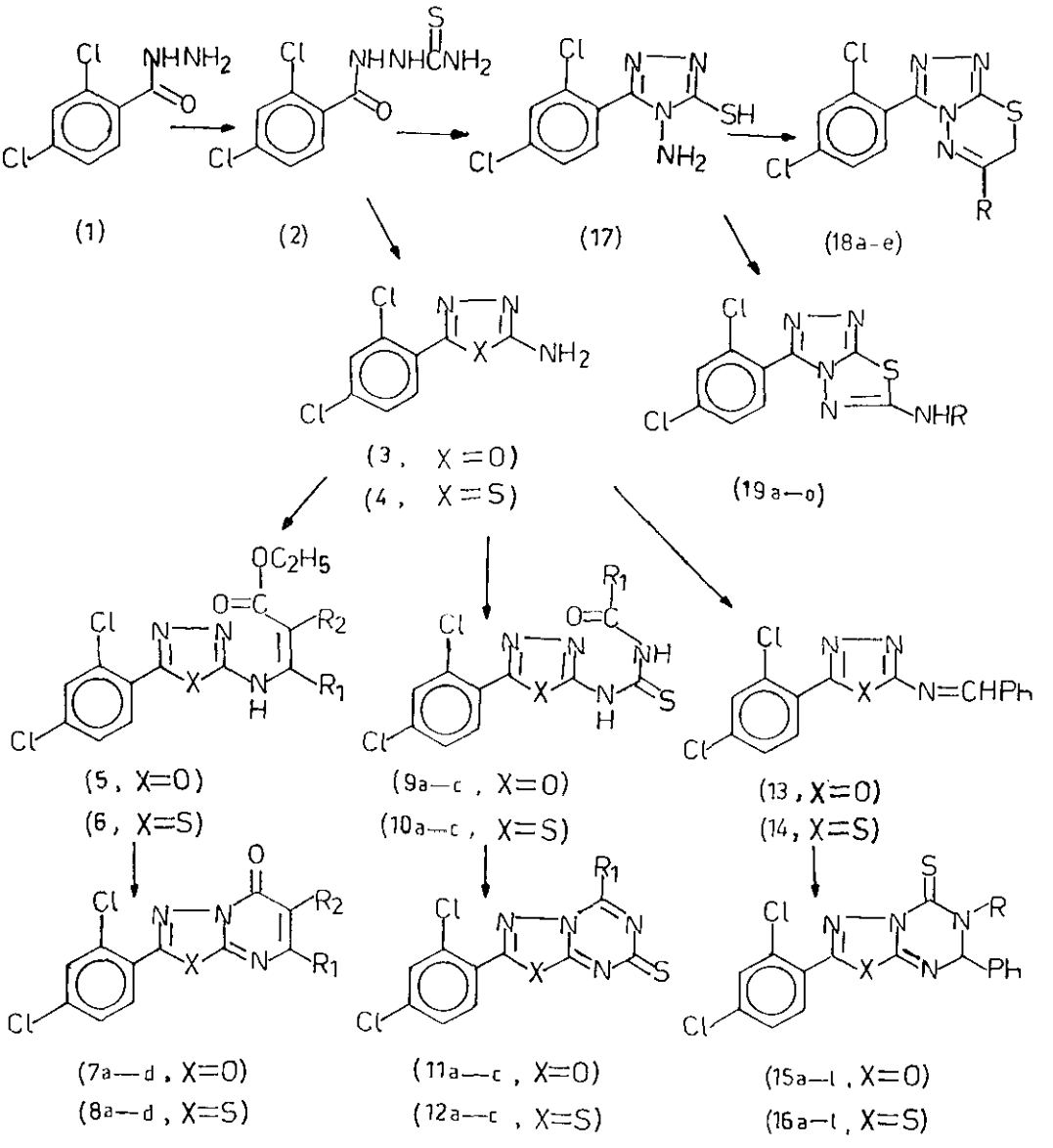
Probin Chandra Gogoi, Mantu Moni Dutta, and
Jiban Chandra Sarmah Kataky*
Regional Research Laboratory, Jorhat 785006, Assam, India

Abstract - 1,3,4-Oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7a-d, 8a-d), 1,3,4-oxa/thiadiazolo(3,2-a)(1,3,5)triazin-7-thiones(11a-c, 12a-c), 1,3,4-oxa/thiadiazolo(3,2-a)-(1,3,5)triazine-5(6H,7H)- thiones(15a-l, 16a-l), 1,2,4-triazolo(3,4-b)(1,3,4)thiadiazines (18a-e) and 1,2,4-triazolo(3,4-b)(1,3,4)thiadiazoles (19a-o) were synthesized. The physical and spectral data of the new compounds were described.

The work described here forms a part of our general program[1] on the studies of the chemistry of heterocycles and in particular on bridgehead nitrogen heterocycles.[2a-c] In recent years chemistry of nitrogen bridgehead heterocycles has made an impact in organic chemistry.[3a-c] It was reported that active methylene compounds condensed with 2-amino-1,3,4-oxa/thiadiazoles yielded oxa/thiadiazolo-pyrimidine-5-ones.[4] 2-Amino-1,3,4-oxa/thiadiazoles

[#]Part IV. P. C. Gogoi and J. C. S. Kataky, Heterocycles, 1991, 32, 237.

on treatment with acyl chlorides and ammonium thiocyanate gave the fused 2,5-disubstituted 1,3,4-oxa/thiadiazolo(3,2-a)(1,3,5)triazin-7-thiones.[5] Cycloaddition reactions of aryl isothiocyanates to 2-benzylideneamino derivatives of 5-substituted 1,3,4-oxa/thiadiazoles constitute an ideal approach to the synthesis of bridgehead nitrogen heterocycles.[3e,f] Cyclocondensation of 4-amino-3-aryl-1,2,4-triazole-5-thiol with α-chloroacetonitrile, α-halocarbonyl compounds and isothiocyanates is another approach for the synthesis of 7H-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazine,[6] and 1,2,4-triazolo(3,4-b)(1,3,4)thiadiazole.[7,8] In a continuation of our interest in the chemistry of bridgehead nitrogen heterocycles[1h,2a-c] we wish to describe here the synthesis of the fused 1,3,4-oxa/thiadiazoles and 1,2,4-triazoles. Exploration of these studies is principally directed towards the synthesis of new nitrogen bridged heterocycles. The results obtained during this attempt are reported in this paper. The required 2-amino-5-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazoles (3,4) were prepared by the reaction of 2,4-dichlorobenzohydrazide (1) with potassium thiocyanate and concentrated hydrochloric acid and subsequent cyclization of 2 in presence of iodine in potassium iodide or phosphoric acid respectively.[9] The reaction of 2-amino-5-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazoles (3,4) with ethyl acetoacetate or diethyl malonate gave 7-substituted 2-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7a-b, 8a-b). When the reaction with diethyl malonate was carried out in the presence of phosphoryl chloride and polyphosphoric acid (PPA) the cyclized products 7-chloro-2-(2,4-dichlorophenyl)-5H-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7c,8c) were obtained. The same reaction of compound 3/4 when carried out with diethyl ethoxymethylenemalonate (DEMM) gave the cyclised product 6-ethoxycarbonyl-2-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7d,8d). The reaction took place also with the formation of the uncyclized products (5,6) which were isolated and characterized. These uncyclized products were formed when the reactions were carried out at room temperature and the products isolated were subsequently cyclized to the desired compounds. In a


(1)
(2)
(17)
(18a-e)
(3, X=O)
(4, X=S)
(19a-o)
(5, X=O)
(6, X=S)
(9a-c, X=O)
(10a-c, X=S)
(13, X=O)
(14, X=S)
(7a-d, X=O)
(8a-d, X=S)
(11a-c, X=O)
(12a-c, X=S)
(15a-l, X=O)
(16a-l, X=S)

Scheme 1

similar manner 5-alkyl/aryl-2-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazolo (3,2-a)(1,3,5)triazin-7-thiones (11a-c, 12a-c) were obtained by the reaction of the amino compounds (3,4) with acyl halides and ammonium thiocyanates in acetone which gave the uncyclized thiourea derivatives (9a-c, 10a-c) then cyclized in the presence of phosphoryl chloride and phosphorus pentachloride to give the compounds (11a-c, 12a-c)(Scheme 1). 5-(2,4-Dichlorophenyl)-1,3,4-oxa/thiadiazol-2-iminobenzylidine (13,14) were prepared by the reaction of 3/4 with benzaldehyde using the reported method.[1f]

Benzylidene derivatives (13,14) react with aryl isothiocyanates in refluxing toluene to give 1,4-cycloadducts (15a-l, 16a-l). 4-Amino-3-(2,4-dichlorophenyl)-1,2,4-triazol-5-thiol (17) was prepared by the reaction of 2,4-dichlorobenzoylhydrazine (1) and carbon disulphide in presence of potassium hydroxide and subsequent cyclisation in presence of hydrazine hydrate (98%) using the reported method.[1a] Triazole (17) reacts with phenacyl halides in ethanol followed by neutralization with potassium carbonate afforded 7H-6-aryl-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazine (18a-d). Triazole (17) reacts with chloroacetonitrile to give cyanomethylthio derivative which on cyclization gave 7H-6-amino-3-(2,4-dichlorophenyl)-1,2,4-triazolo-(3,4-b)(1,3,4)thiadiazine (18e, R=$NH_2$). Triazole (17) reacts with aryl isothiacyanates in dry dimethylformamide at room temperature to afford the uncyclized substituted thiourea derivatives which upon refluxing had cyclized into 6-arylamino-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazoles (19a-m).[8b] In our attempt the reaction was carried in presence of dicyclohexylcarbodiimide (DCC) and fused triazoles were formed. Cyanogen bromide is finding increasing use in heterocyclic synthesis[7] and when used in place of aryl isothiocyanates it gave 6-amino-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazole (19n, R=H). Triazole (17) on reaction with benzoyl isothiocyanate[10] in acetone yielded 6-benzoylamino-3(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazole (19o, R=$COC_6H_5$)(Scheme 1).

## EXPERIMENTAL

Melting points were determined with a Buchi oil heated apparatus in open capillaries and are uncorrected. Ir spectra were recorded with a Perkin-Elmer 580B spectrophotometer using potassium bromide discs unless otherwise stated ($\nu_{max}$ in $cm^{-1}$). $^1H$ Nmr spectra were recorded in solutions stated with TMS as the internal reference in 60 MHz and 90 MHz on a Varian T-60 and Zeol Fx-90 spectrometers (chemical shifts in $\delta$ ppm). 2,4-Dichlorobenzhydrazide (1) was prepared from ethyl 2,4-dichlorobenzoate following the reported method.[1b] 2-Amino-5-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazoles (3,4) were prepared using the known method.[9] 4-Amino-3-(2,4-dichlorophenyl)-1,2,4-triazol-5-thiol (17) was prepared using the method of Goswami et al.[1a]

### 2-(2,4-Dichlorophenyl)-7-methyl-5H-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7a, 8a)

A mixture of compound (3)(1.61 g, 0.007 mol), ethyl acetoacetate (2 g, 0.015 mol) and p-toluenesulphonic acid (0.1 g) in toluene (100 ml) was refluxed for 24 h using a Dean Stark apparatus to remove water. The reaction mixture was cooled to room temperature and diluted with 100 ml of cyclohexane to give a grey solid. The solid was filtered and crystallized from $C_2H_5OH$ to give compound 7a. The filtrate was evaporated and triturated with cyclohexane to give a pasty mass which was dissolved in $C_2H_5OH$ and filtered hot. The solution on cooling gave colourless solid of ethyl 3-(5-(2,4-dichlorophenyl)-1,3,4-oxadiazol-2-ylamino)-2-butenoate (5)(0.7 g). Compound (5)(0.5 g, 0.0015 mol) and p-toluenesulphonic acid (0.1 g) in toluene (30 ml) was refluxed for 36 h. The solvent was evaporated to half and the residue was cooled to room temperature to give a solid which was filtered and crystallized from $C_2H_5OH$ to afford compound 7a. Similarly the compound (8a) was also prepared. The physical and spectral data of these compounds are given in Table 1 and Table 2.

### 2-(2,4-Dichlorophenyl)-7-hydroxy-5H-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7b, 8b)

A mixture of compound (3)(2.3 g, 0.01 mol), diethyl malonate (DEM)

(3.2 g, 0.02 mol), p-toluenesulphonic acid (0.1 g) and 1,2,4-trichlorobenzene (25 ml) was heated at 240°C for 2 h. The oily mass was dissolved in ethyl acetate and filtered through a silica gel column. The filtrate was evaporated and the solid mass thus obtained was refluxed in toluene (12 ml) and p-toluenesulphonic acid (0.001 g) for 40 h. Then the solvent was removed and the solid obtained was crystallized from $C_2H_5OH$ to give compound 7b. Similarly compound (8b) was also prepared.

7-Chloro-2-(2,4-dichlorophenyl)-5H-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7c, 8c)

A mixture of compound (3)(2,3 g, 0.01 mol), diethyl malonate (3.2 g, 0.02 mol) and phosphoryl chloride (4.6 g, 0.03 mol) was heated in presence of PPA (1 g) at 120°C for 3 h. Dry $C_2H_5$-OH was then carefully added and the resulting solid was filtered and washed with ether. It was then neutralized with 10% aqueous sodium hydrogen carbonate solution and recrystallized from acetone:hexane mixture (3:1) to afford compound 7c. Similarly compound (8c) was also prepared.

6-Ethoxycarbonyl-2-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazolo(3,2-a)pyrimidin-5-ones (7d, 8d)

A mixture of compound (3)(2.3 g, 0.01 mol) and DEMM (3.2 g, 0.015 mol) was heated at 170-180°C for 6 h. The reaction mixture was then cooled, filtered and washed with petroleum spirit and then with ethyl acetate. The solid thus separated was recrystallized from acetone to afford compound 7d. Following the same procedure compound (8d) was prepared. The physical and spectral data are given in Table 1 and Table 2.

N-Acyl-N'-(5-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazol-2-yl)thiourea (9a-c, 10a-c)

A mixture of ammonium thiocyanate (0.076 g, 0.01 mol) and acid chloride

(0.01 mol) in acetone (25 ml) was refluxed for 30 min. Compound (3)(2.3 g, 0.01 mol) was then added to it and the mixture was refluxed further 3 h. The mixture was then poured into excess water (500 ml). The resulting solid was dried and crystallized from $C_2H_5OH$ : acetone (50 : 50 v/v) to give compound (9a). Following the same procedure compounds (9b-c, 10b-c) were prepared.

5-Alkyl/aryl-2-(2,4-dichlorophenyl)-1,3,4-oxa/thiadiazolo(3,2-a)(1,3,5)-triazin-7-thiones (11a-c, 12a-c)

A mixture of compounds (9a-c)(0.015 mol), phosphoryl chloride (15 ml, 0.16 mol) and phosphorus pentachloride (3.12 g, 0.015 mol) was refluxed for 4 h. The excess phosphoryl chloride was then removed by distillation and the residue was poured into crushed ice. The resulting solid was filtered, washed with water and crystallized from $C_2H_5OH$ to give compounds (11a-c). The same procedure was followed to convert (10a-c) to (12a-c). The physical and spectral data are given in Table 1 and Table 2.

5-(2,4-Dichlorophenyl)-2-iminobenzylideneamino-1,3,4-oxa/thiadiazoles (13,14)

A mixture of 3,4 (0.01 mol) and benzaldehyde (1.06 g, 0.01 mol) was refluxed in $C_2H_5OH$ (50 ml) in the presence of 2 drops of piperidine. After refluxing for 2 h, solvent was removed under reduced pressure to give solid on cooling. The solid was filtered and recrystallized from $C_2H_5OH$ to get compounds (13,14)(80% yield).

6-Aryl-2-(2,4-dichlorophenyl)-7-phenyl-1,3,4-oxa/thiadiazolo(3,2-a)(1,3,5)-triazin-5(6H,7H) thiones (15a-l, 16a-l)

General Method :

A mixture of compounds (13,14)(0.01 mol) and aryl isothiocyanates (0.01 mol) in toluene (100 ml) was refluxed for 6 h. The solvent was removed by distillation and the residue was washed with small amount of $C_2H_5OH$ (15 ml) followed by water (25 ml). The solid was recrystallised from $C_2H_5OH$ to give

Table 1 : Physical data of compounds (7-19)

| Compd No | R/$R_1$ | $R_2$ | Yield (%) | mp (°C) | Analysis (%) Found C | Found H | Found N | Calcd C | Calcd H | Calcd N |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 7a | $CH_3$ | H | 84 | 219 | 48.60 | 2.30 | 14.12 | 48.64 | 2.36 | 14.18 |
| 7b | OH | H | 70 | 198 | 44.21 | 1.61 | 14.03 | 44.29 | 1.68 | 14.09 |
| 7c | Cl | H | 70 | 215 | 41.70 | 1.20 | 13.25 | 41.77 | 1.27 | 13.29 |
| 7d | H | $COOC_2H_5$ | 70 | 220 | 47.42 | 2.49 | 11.82 | 47.45 | 2.54 | 11.86 |
| 8a | $CH_3$ | H | 73 | 215 | 46.10 | 2.18 | 13.40 | 46.15 | 2.24 | 13.46 |
| 8b | OH | H | 86 | 205 | 42.10 | 1.50 | 13.30 | 42.03 | 1.53 | 13.37 |
| 8c | Cl | H | 74 | 221 | 39.70 | 1.16 | 12.59 | 39.75 | 1.20 | 12.65 |
| 8d | H | $COOC_2H_5$ | 71 | 212 | 45.49 | 2.40 | 11.29 | 45.40 | 2.43 | 11.35 |
| 9a | $CH_3$ | - | 70 | 208 | 39.81 | 2.38 | 16.89 | 39.87 | 2.42 | 16.91 |
| 9b | $C_6H_5$ | - | 72 | 200 | 48.80 | 2.50 | 14.28 | 48.85 | 2.54 | 14.24 |
| 9c | 2,4-$Cl_2$-$C_6H_3$ | - | 81 | 187 | 41.50 | 1.70 | 12.18 | 41.55 | 1.73 | 12.12 |
| 10a | $CH_3$ | - | 83 | 290 | 38.09 | 2.28 | 16.19 | 38.04 | 2.31 | 16.13 |
| 10b | $C_6H_5$ | - | 79 | 224 | 46.98 | 2.40 | 13.60 | 46.94 | 2.44 | 13.69 |
| 10c | 2,4-$Cl_2$-$C_6H_3$ | - | 82 | 192 | 40.12 | 1.60 | 11.78 | 40.16 | 1.67 | 11.71 |
| 11a | $CH_3$ | - | 71 | 198 | 42.11 | 1.58 | 17.82 | 42.17 | 1.61 | 17.89 |
| 11b | $C_6H_5$ | - | 68 | 178 | 51.28 | 2.09 | 14.98 | 51.20 | 2.13 | 14.93 |
| 11c | 2,4-$Cl_2$-$C_6H_3$ | - | 72 | 172 | 43.28 | 1.30 | 12.67 | 43.24 | 1.35 | 12.61 |
| 12a | $CH_3$ | - | 75 | 261 | 40.18 | 1.78 | 17.08 | 40.12 | 1.82 | 17.02 |
| 12b | $C_6H_5$ | - | 69 | 201 | 49.16 | 2.01 | 14.38 | 49.10 | 2.05 | 14.32 |
| 12c | 2,4-$Cl_2$-$C_6H_3$ | - | 72 | 180 | 41.76 | 1.27 | 12.13 | 41.73 | 1.30 | 12.17 |
| 13 | - | - | 80 | 205 | 56.65 | 2.80 | 13.10 | 56.60 | 2.83 | 13.20 |
| 14 | - | - | 80 | 222 | 53.82 | 2.61 | 12.53 | 53.89 | 2.69 | 12.57 |
| 15a | $C_6H_5$ | - | 65 | 210 | 58.35 | 3.05 | 12.38 | 58.28 | 3.09 | 12.36 |
| 15b | 4-Br-$C_6H_4$ | - | 72 | 230 | 49.68 | 2.41 | 10.55 | 49.62 | 2.44 | 10.53 |
| 15c | 4-Cl-$C_6H_4$ | - | 70 | 190 | 54.27 | 2.61 | 11.58 | 54.21 | 2.67 | 11.50 |
| 15d | 2-Cl-$C_6H_4$ | - | 75 | 180 | 54.26 | 2.63 | 11.56 | 54.21 | 2.67 | 11.50 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| 15e | 3-Cl-$C_6H_4$ | - | 72 | 210 | 54.27 | 2.62 | 11.58 | 54.21 | 2.67 | 11.50 |
| 15f | 2-$NO_2$-$C_6H_4$ | - | 68 | 220 | 53.11 | 2.55 | 14.10 | 53.01 | 2.61 | 14.06 |
| 15g | 4-$NO_2$-$C_6H_4$ | - | 68 | 235 | 53.09 | 2.58 | 14.03 | 53.01 | 2.61 | 14.06 |
| 15h | 3-$NO_2$-$C_6H_4$ | - | 70 | 260 | 53.08 | 2.57 | 14.12 | 53.01 | 2.61 | 14.06 |
| 15i | 2-$CH_3$-$C_6H_4$ | - | 72 | 205 | 59.15 | 3.41 | 11.95 | 59.10 | 3.43 | 11.99 |
| 15j | 4-$CH_3$-$C_6H_4$ | - | 65 | 209 | 59.18 | 3.40 | 12.00 | 59.10 | 3.43 | 11.99 |
| 15k | 2-$OCH_3$-$C_6H_4$ | - | 72 | 195 | 57.10 | 3.27 | 11.53 | 57.14 | 3.31 | 11.59 |
| 15l | 4-$OCH_3$-$C_6H_4$ | - | 70 | 229 | 57.19 | 3.27 | 11.53 | 57.14 | 3.31 | 11.59 |
| 16a | $C_6H_5$ | - | 65 | 202 | 56.32 | 2.91 | 11.98 | 56.29 | 2.98 | 11.94 |
| 16b | 4-Br-$C_6H_4$ | - | 62 | 195 | 48.12 | 2.30 | 10.25 | 48.18 | 2.37 | 10.22 |
| 16c | 4-Cl-$C_6H_4$ | - | 70 | 190 | 52.52 | 2.50 | 11.18 | 52.49 | 2.58 | 11.13 |
| 16d | 2-Cl-$C_6H_4$ | - | 80 | 220 | 52.55 | 2.52 | 11.15 | 52.49 | 2.58 | 11.13 |
| 16e | 3-Cl-$C_6H_4$ | - | 65 | 218 | 52.46 | 2.53 | 11.19 | 52.49 | 2.58 | 11.13 |
| 16f | 2-$NO_2$-$C_6H_4$ | - | 72 | 206 | 51.38 | 2.50 | 13.65 | 51.36 | 2.53 | 13.62 |
| 16g | 4-$NO_2$-$C_6H_4$ | - | 59 | 190 | 51.42 | 2.49 | 13.65 | 51.36 | 2.53 | 13.62 |
| 16h | 3-$NO_2$-$C_6H_4$ | - | 62 | 228 | 51.40 | 2.49 | 13.64 | 51.36 | 2.53 | 13.62 |
| 16i | 2-$CH_3$-$C_6H_4$ | - | 72 | 230 | 52.18 | 3.32 | 11.52 | 57.14 | 3.31 | 11.59 |
| 16j | 4-$CH_3$-$C_6H_4$ | - | 70 | 252 | 52.19 | 3.28 | 11.55 | 57.14 | 3.31 | 11.59 |
| 16k | 2-$OCH_3$-$C_6H_4$ | - | 65 | 205 | 55.38 | 3.18 | 11.28 | 55.31 | 3.21 | 11.22 |
| 16l | 4-$OCH_3$-$C_6H_4$ | - | 68 | 209 | 55.36 | 3.25 | 11.27 | 55.31 | 3.21 | 11.22 |
| 18a | $CH_3$ | - | 45 | 180 | 44.27 | 2.74 | 18.65 | 44.15 | 2.66 | 18.73 |
| 18b | $C_6H_5$ | - | 50 | 220 | 53.25 | 2.68 | 15.40 | 53.18 | 2.77 | 15.51 |
| 18c | 2,4-$Cl_2$-$C_6H_3$ | - | 60 | 210 | 44.42 | 1.73 | 13.05 | 44.65 | 1.86 | 13.02 |
| 18d | 4-Br-$C_6H_4$ | - | 65 | 180 | 43.82 | 2.11 | 12.84 | 43.63 | 2.04 | 12.72 |
| 18e | $NH_2$ | - | 62 | 250 | 40.10 | 2.38 | 23.40 | 40.00 | 2.33 | 23.33 |
| 19a | $C_6H_5$ | - | 55 | 215 | 49.82 | 2.54 | 19.38 | 49.72 | 2.48 | 19.34 |
| 19b | 4-Br-$C_6H_4$ | - | 60 | 280 | 40.92 | 1.87 | 15.80 | 40.82 | 1.81 | 15.87 |
| 19c | 4-Cl-$C_6H_4$ | - | 65 | 250 | 45.39 | 2.10 | 17.69 | 45.34 | 2.01 | 17.63 |
| 19d | 2-Cl-$C_6H_4$ | - | 68 | 189 | 45.30 | 2.08 | 17.70 | 45.34 | 2.01 | 17.63 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| 19e | 3-Cl-$C_6H_4$ | - | 65 | 230 | 45.38 | 2.09 | 17.69 | 45.34 | 2.01 | 17.63 |
| 19f | 2-$NO_2$-$C_6H_4$ | - | 75 | 190 | 44.28 | 1.91 | 20.71 | 44.23 | 1.96 | 20.64 |
| 19g | N-$NO_2$-$C_6H_4$ | - | 65 | 280 | 44.27 | 1.92 | 20.72 | 44.23 | 1.96 | 20.64 |
| 19h | 3-$NO_2$-$C_6H_4$ | - | 70 | 275 | 44.28 | 1.91 | 20.70 | 44.23 | 1.96 | 20.64 |
| 19i | 2-$CH_3$-$C_6H_4$ | - | 50 | 210 | 51.12 | 2.98 | 18.61 | 51.06 | 2.92 | 18.62 |
| 19j | 4-$CH_3$-$C_6H_4$ | - | 55 | 230 | 51.15 | 2.95 | 18.68 | 51.06 | 2.92 | 18.62 |
| 19k | 2-$OCH_3$-$C_6H_4$ | - | 60 | 260 | 48.90 | 2.85 | 17.91 | 48.98 | 2.81 | 17.86 |
| 19l | 4-$OCH_3$-$C_6H_4$ | - | 65 | 280 | 48.95 | 2.86 | 17.95 | 48.98 | 2.81 | 17.86 |
| 19m | $C_6H_4CH_2$ | - | 50 | 198 | 51.28 | 2.60 | 18.72 | 51.20 | 2.66 | 18.66 |
| 19n | H | - | 50 | 240 | 37.81 | 1.80 | 24.53 | 37.76 | 1.74 | 24.47 |
| 19o | $COC_6H_5$ | - | 49 | 160 | 49.28 | 2.38 | 17.90 | 49.23 | 2.31 | 17.95 |

Table 2 : Spectral data of compounds (7-19)

| Compd No | ir (KBr) $\nu$ $cm^{-1}$ | $^1H$ nmr ($\delta$ ppm, DMSO-$d_6$) |
|---|---|---|
| 1 | 2 | 3 |
| 7a | 1695 | 3.4(s, 3H), 6.5(s, 1H), 7.2-7.6(m, Ar-H) |
| 7b | 1700, 3300 | 6.5(s, 1H), 7.1-7.5(m, Ar-H) |
| 7c | 1695 | 6.5(s, 1H), 7.3-7.6(m, Ar-H) |
| 7d | 1680, 1710 | 1.4(t, J=7Hz, 3H), 4.4(q, J=7Hz, 2H), 7.1(s, 1H), 7.2-7.7(m, Ar-H) |
| 8a | 1690 | 3.5(s, 3H), 6.8(s,1H), 7.5-7.8(m, Ar-H) |
| 8b | 1700, 3300 | 6.5(s, 1H), 7.2-7.5(m, Ar-H) |
| 8c | 1680 | 6.7(s, 1H), 7.5-7.8(m, Ar-H) |
| 8d | 1690, 1720 | 1.3(t, J=7Hz, 3H), 4.4(q, J=7Hz, 2H), 7.1(s, 1H), 7.5-7.8(m, Ar-H) |
| 9a | 1035, 1100, 1600, 1660 | 2.3(s, 3H), 7.4-7.7(m, Ar-H) |
| 9b | 1035, 1100, 1660, 3320 | 7.3-7.8(m, Ar-H) |
| 9c | 1030, 1100, 1660, 3300 | 7.4-7.7(m, Ar-H) |
| 10a | 1060, 1610, 1670, 3320 | 2.2(s, 3H), 7.5-7.7(m, Ar-H) |
| 10b | 1060, 1610, 1670, 3330 | 7.4-8.0(m, Ar-H) |
| 10c | 1060, 1610, 1665, 3320 | 7.4-7.9(m, Ar-H) |
| 11a | 1030, 1090 | 2.2(s, 3H), 6.9-7.2(m, Ar-H) |
| 11b | 1030, 1100 | 6.8-7.8(m, Ar-H) |
| 11c | 1030, 1100 | 6.8-7.6(m, Ar-H) |
| 12a | 1070 | 6.6-7.0(m, Ar-H) |
| 12b | 1075 | 6.7-7.7(m, Ar-H) |
| 12c | 1070 | 6.6-7.4(m, Ar-H) |

| 1 | 2 | 3 |
|---|---|---|
| 13 | 1610, 1030 | 6.7(s, 1H), 6.9-7.4(m, Ar-H) |
| 14 | 1600, 680 | 6.8(s, 1H), 7.2-7.5(m, Ar-H) |
| 15a | 1090, 1030 | 5.2(s, 1H), 6.9-7.4(m, Ar-H) |
| 15b | 1100, 1030 | 5.2(s, 1H), 7.1-7.5(m, Ar-H) |
| 15c | 1100, 1030 | 5.3(s, 1H), 6.8-7.5(m, Ar-H) |
| 15d | 1100, 1035 | 5.2(s, 1H), 7.3-7.8(m, Ar-H) |
| 15e | 1095, 1030 | 5.2(s, 1H), 7.2-7.5(m, Ar-H) |
| 15f | 1090, 1030 | 5.1(s, 1H), 7.1-7.6(m, Ar-H) |
| 15g | 1100, 1030 | 5.2(s, 1H), 7.2-7.5(m, Ar-H) |
| 15h | 1105, 1030 | 5.3(s, 1H), 6.9-7.4(m, Ar-H) |
| 15i | 1100, 1030 | 1.9(s, 3H), 5.2(s, 1H), 7.2-7.6(m, Ar-H) |
| 15j | 1090, 1030 | 1.7(s, 3H), 5.3(s, 1H), 6.9-7.5(m, Ar-H) |
| 15k | 1090, 1030 | 3.5(s, 3H), 5.2(s, 1H), 6.9-7.5(m, Ar-H) |
| 15l | 1100, 1030 | 3.5(s, 3H), 5.2(s, 1H), 7.2-7.8(m, Ar-H) |
| 16a | 1080, 680 | 5.2(s, 1H), 6.8-7.5(m, Ar-H) |
| 16b | 1100, 685 | 5.2(s, 1H), 7.2-7.5(m, Ar-H) |
| 16c | 1100, 685 | 5.2(s, 1H), 7.0-7.6(m, Ar-H) |
| 16d | 1090, 680 | 5.1(s, 1H), 6.9-7.4(m, Ar-H) |
| 16e | 1080, 680 | 5.2(s, 1H), 7.2-7.5(m, Ar-H) |
| 16f | 1090, 680 | 5.3(s, 1H), 7.1-7.6(m, Ar-H) |
| 16g | 1100, 685 | 5.3(s, 1H), 7.2-7.5(m, Ar-H) |
| 16h | 1100, 680 | 5.2(s, 1H), 6.8-7.3(m, Ar-H) |
| 16i | 1090, 680 | 1.9(s, 3H), 5.1(s, 1H), 7.2-7.5(m, Ar-H) |
| 16j | 1100, 680 | 1.7(s, 3H), 5.1(s, 1H), 6.8-7.4(m, Ar-H) |
| 16k | 1100, 680 | 3.5(s, 3H), 5.2(s, 1H), 6.9-7.5(m, Ar-H) |
| 16l | 1080, 690 | 3.5(s, 3H), 5.2(s, 1H), 7.0-7.6(m, Ar-H) |
| 18a | 1600 | 1.3(s, 3H), 3.8(s, 2H), 7.3-8.1(m, Ar-H) |
| 18b | 1610 | 3.9(s, 2H), 7.5-8.2(m, Ar-H) |
| 18c | 1600 | 3.8(s, 2H), 7.1-8.0(m, Ar-H) |

| 1 | 2 | 3 |
|---|---|---|
| 18d | 1600 | 4.2(s, 2H), 7.2-7.9(m, Ar-H) |
| 18e | 3200, 1600 | 3.9(s, 2H), 6.9(s, 2H), 7.2-8.0(m, Ar-H) |
| 19a | 3250, 1610 | 7.4-8.2(m, Ar-H), 10.6(s, 1H) |
| 19b | 3200, 1615 | 7.8-8.3(m, Ar-H), 10.8(s, 1H) |
| 19c | 3300, 1620 | 7.0-8.1(m, Ar-H), 10.7(s, 1H) |
| 19d | 3200, 1600 | 7.5-8.2(m, Ar-H), 10.8(s, 1H) |
| 19e | 3200, 1610 | 7.2-8.0(m, Ar-H), 10.5(s, 1H) |
| 19f | 3250, 1615 | 7.2-8.1(m, Ar-H), 10.7(s, 1H) |
| 19g | 3200, 1600 | 7.0-7.8(m, Ar-H), 10.8(s, 1H) |
| 19h | 3250, 1610 | 7.4-8.0(m, Ar-H), 10.7(s, 1H) |
| 19i | 3280, 1620 | 2.5(s, 3H), 7.1-7.8(m, Ar-H), 10.6(s, 1H) |
| 19j | 3200, 1600 | 2.4(s, 3H), 7.2-7.8(m, Ar-H), 10.8(s, 1H) |
| 19k | 3250, 1600 | 3.8(s, 3H), 7.0-7.8(m, Ar-H), 10.6(s, 1H) |
| 19l | 3200, 1610 | 3.6(s, 3H), 7.2-8.1(m, Ar-H), 10.8(s, 1H) |
| 19m | 3250, 1600 | 3.9(s, 3H), 7.0-7.9(m, Ar-H), 10.7(s, 1H) |
| 19n | 3200, 1610 | 7.7(s, 2H), 6.8-7.3(m, Ar-H) |
| 19o | 3020, 1610 | 6.8-7.2(m, Ar-H), 10.2(s, 1H) |

pure products (15a-l, 16a-l). The physical data of the compounds are given in Table 1 and Table 2.

7H-6-Aryl-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazine (18a-d)

General Method :

Aroylmethyl halid (0.01 mol) was added dropwise to a stirred solution of the triazole (17)(2.61 g, 0.01 mol) in absolute $C_2H_5OH$ (50 ml). The mixture was then refluxed for 5 h, cooled to room temperature and neutralized with 10% aqueous sodium carbonate solution. The solid product was recrystallized from $C_2H_5OH$ water mixture to give pure product (18a-d).

7H-6-Amino-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazine (18e)

Triazole (17)(2.61 g, 0.01 mol) dissolved in 30 ml of absolute $C_2H_5OH$ was mixed with 1.2 ml (0.02 mol) of chloroacetonitrile and heated for 4 h. The solvent was removed and the residue was dissolved in 25 ml of water. After neutralization with 10% aqueous sodium carbonate gave a precipitate which was filtered, washed with cold water (2 x 20 ml) and dissolved in 20 ml of concentrated sulphuric acid and left for 3 h at room temperature. It was then diluted with water and neutralized with 20% ammonium hydroxide. The precipitated product was filtered and crystallized from $C_2H_5OH$ water mixture to give compound (18e).

6-Arylamino-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazoles (19a-m)

General Method :

Aryl isothiocyanate (0.015 mol) was added to a solution of the triazole (17) (2.61 g, 0.01 mol) in absolute $C_2H_5OH$ (150 ml) and the mixture was stirred for 4 h. To the stirred solution, dicyclohexylcarbodiimide (DCC)(3.1 g, 0.015 mol) was added and the whole mixture was refluxed for 6 h. On cooling to room temperature a white solid was separated. The solid was filtered and recrystallized from $C_2H_5OH$ to give the products (19a-m).

6-Amino-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)thiadiazole (19n)

Cyanogen bromide (2.1 g, 0.02 mol) and the triazole (17)(2.61 g, 0.01 mol) were refluxed in 75% aqueous $C_2H_5OH$ (50 ml) for 4 h. The reaction mixture was evaporated to one fourth of its volume and then diluted with a saturated solution of sodium acetate in water. The precipitated solid was filtered and recrystallized from $C_2H_5OH$ to afford compound (19n).

6-Benzoylamino-3-(2,4-dichlorophenyl)-1,2,4-triazolo(3,4-b)(1,3,4)-thiadiazole (19o)

To a stirred solution of ammonium thiocyanate (0.76 g, 0.01 mol) in acetone

(30 ml), benzoyl chloride (1.41 g, 0.01 mol) was added. The mixture was stirred for 15 min and a solution of the triazole (17)(2.61 g, 0.01 mol) in acetone (50 ml) was added into the mixture. The mixture was then heated under reflux for 3 h. The solvent was partly removed and cooled to room temperature. The mixture was then diluted with ice cooled water. The solid thus separated was filtered, washed with 5% aqueous sodium hydrogen carbonate solution and then with water (2 x 25 ml). The solid was recrystallized from acetone to give the pure compound (19o).

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