Research Journal Of Chemistry And Environment Vol. 14 (1) March (2009)
Res. J. Chem. Environ.

Synthesis, Characterrization and Biological Evaluation of 3-chloro-1-[3, 6-diphenyl]-[1, 2, 4] Triazole [3, 4-b] [1, 3, 4] Thiadiazole)]-4-substituted-aryl- Azetidine-2-ones

Parmar Kokila A.*, Solanki Dhaval J. and Patel Rekha M.

Department of Chemistry, Himchandracharya North Gujarat University, Patan (Gujarat), INDIA

*rekha_triazole@yahoo.co.in

Abstract

4-amino-5-phenyl-4H-1,2,4-triazole-3-thiol (1) prepared by treating benzoic acid hydrazide successively with CS_2, KOH and NH_2 NH_2 give the nitrogen bridge head fused heteocycles (3) on reacting with N-acetyl-p-amino benzoic acid followed by hydrolysis. It was facile condensation reaction with various substituted aromatic aldehydes yielding Schiff bases/ anils/Azomethines (4a-h). These anils on cyclo-condensation reaction with Chloro acetyl chloride yield 2-Azetidinones (5a-h). These compounds were screened for activities against bacterial and fungal strains.

Keywords: Schiff bases, 2-Azetidinones, Cyclo-condensation reaction, facile condensation, Anti microbial activity.

Introduction

Literature survey reveals that 1,2,4-triazole nucleus is associated with diverse pharmacological activities such as anti-inflammatory[1], diuretic[2], antiviral[3], antihypertensive[4], anthalmentic[5], bactericidal[6], anticonvulsant[7], herbicidal[8], insecticidal and acaricidal[9], fungicidal[10], antimicrobial[11], anticancer and anti-HIV[12], plant growth regulator[13], antiieishmanial[14], antitumor[15], antidepressant and anxiolytic[16],anti-tuberculosis[17], mycobacterial activity[18], A_{2A} receptor antagonists[19], corrosion inhibitor [20], analgesic[21] and antifungal activity[22]. Triazoles are reported as antiheumatic agents[23]. Mohammad[24] has also reported anti-inflammatory activity of 1, 2, 4-triazole derivatives. Mohan et al[25] have synthesized thiazolo triazoles and studied their antimicrobial activity.

Pharmaceutically important molecule 2-Azetidinones[26-27] have played an important role in medicinal chemistry. Moreover, they have been studied extensively because of their ready accessibility and broad spectrum of biological activities.

Biological activities

Antibacterial Activity: Compounds (5a-h) were tested for in vitro antibacterial activity against gram -ve bacteria *Escherichia Coli* and *Peudomonas Aeruginosa* and *gram +ve bacteria*, *Staphylococcus Aureus* and *Bacillus Subtills*. The standard drugs used were ampicillin and tetracycline. The investigation of antibacterial screening reported in table I revealed that some of the newly synthesized compounds showed moderate to good inhibition at 100 µg/ml in DMF.Compounds 5d, 5e, 5f, 5g, 5h, 5g exhibited good activity against all the four bacterial strains. Compounds 5f and 5h showed good activity against *E.Coli* and *S. Aureus* bacterial strains.

Antifungal Activity: The compounds (5a-h) were tested for in vitro antifungal activity against *Candida Albicans* and *Aspergillus Niger*. The standard drug used was Griseofulvin. The investigation antifungal screening reported in table I. Compounds 5d, 5f, 5h show good activity against *C. Albicans* fungal strain. Rest of all compounds do not exhibit good activity against both fungi.

Material and Methods

Melting points were determined with Buchi B-545 melting point apparatus and are uncorrected. IR spectra were recorded on a Perkin-Elmer PE-1600 FTIR Spectrometer in KBr disc. 1H NMR spectra were recorded on a Varian 400 spectrometer in DMSO-d6 as a solvent and TMS as an internal standard. Peak values are shown in δ ppm. EI-MS spectra were measured on a Waters Mass Spectrometer. All of the solvents and materials were reagent grade and purified as required.

Preparation of 4-amino-5-phenyl-4H-1,2,4-triazole-3-thiol (1), 3-(phenyl)-6-(4-N-acetylamino phenyl) [1,2,4] triazolo[3,4-b][1,3,4]thiadiazole (2) and 3-(phenyl)-6-(4-amino phenyl) [1,2,4]triazolo[3,4-b][1,3,4]thiadiazole (3) were prepared as reported in literature. [28]

3-(phenyl)-6-(4-amino phenyl) [1,2,4]triazolo[3,4-b][1,3,4]thiadiazole (3): M.P.:158-160°C; IR(KBr,cm^{-1}): 3362 (-NH_2-),3030-3080(Aromatic C-H Stretching), 1580(-C=N-),692,1630 (-NH- in and out plane); ^{1}HNMR(ä ppm):,6.4-8.86 (multiplet,aromatic),^{13} CNMR(δ ppm): 130-150 (Triazolo-thiadiazole), 115-129 (Benzene, Anal. Calcd. for $C_{15}H_{11}N_5S$; C, 61.4; H, 3.7; N, 23.9; S. 10.9.Found: C, 61.2; H, 3.5; N, 23.7; S, 10.7; Yield, 86%

Preparation of compounds (4a-h)

Preparation of arylidine – [3, 6-(di phenyl)-[1, 2, 4]triazolo [3, 4-b][1, 3, 4]thiadiazole] (4a-h): A mixture of equimolar amount of 3-(phenyl)-6-(4-amino phenyl)

[1,2,4]triazolo[3,4-b][1,3,4]thiadiazole (0.01 mole) and various aromatic aldehydes (0.01 mole) in 50 ml acetic acid was refluxed for about 10-12 hrs. on oil bath with TLC monitoring. The reaction mixture was cooled and it was poured into ice water and extracted with ethyl acetate and water and finally dried over anhydrous sodium sulfate. The solvent was evaporated to give the solid product. It was crystallized from ethyl acetate-hexane using decolorizing charcoal to give various anils (i.e. Schiff bases) (4a-h).

Benzylidine – [3, 6-(di phenyl)-[1, 2, 4]triazolo[3, 4-b][1, 3, 4]thiadiazole].(4a): M.P.:247°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1630(-CH=N-), 1095 (-C-S-); ^{1}HNMR(δ, ppm):,6.4-8.86 (multiplet, aromatic + CH of CH=N protons),^{13} CNMR (δ, ppm): 130-150 (Triazolo-thiadiazole),115-129(Benzene),153(-CH=N-), Anal.Calcd. for $C_{23}H_{17}N_5OS$; C,67.1; H, 4.1; N, 17.0; S, 7.7. Found: C, 67.0; H, 3.9; N, 16.8; S, 7.6; Yield, 63%.

4-Methoxy benzylidine – [3, 6-(di phenyl)-[1, 2, 4] triazolo[3, 4-b][1, 3, 4]thiadiazole].(4b): M.P.: 176°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1630(-CH=N-),1200(Ar-OCH_3),1095(-C-S-); ^{1}HNMR(δ ppm): 6.4-8.86 (multiplet,aromatic + CH of CH=N protons), 3.85(3H, S,-OCH_3), ^{13}CNMR(δ ppm): 130-150 (Triazolo-thiadiazole), 115-129(Benzene), 153(-CH=N-), Anal.Calcd. for $C_{22}H_{15}N_5S$; C,69.2; H,3.9; N,18.3; S,8.3. Found: C,69.2; H,3.9; N,18.3; S,8.3 Yield, 62%.

4-Hydroxy benzylidine-[3,6-(di phenyl)-[1, 2, 4]triazolo[3, 4-b][1, 3, 4]thiadiazole].(4c): M.P.: 273°C; IR(KBr, cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1630(-CH=N-), 1095(-C-S-); ^{1}HNMR(δ ppm):3.85 (1H, s, OH),6.4-8.86 (multiplet,aromatic+ CH of CH=N protons),^{13}CNMR(δ, ppm): 130-150(Triazolo-thiadiazole),115-129(Benzene), 153(-CH=N-), Anal.Calcd.for $C_{22}H_{15}N_5SO$;C,66.4; H,3.7; N,17.6; S, 8.0.Found: C,66.0; H, 3.7; N,17.4; S,7.8 Yield, 69%.

2-Hydroxy benzylidine-[3,6-(di phenyl)-[1, 2, 4]triazolo[3, 4-b][1, 3, 4]thiadiazole].(4d): M.P.:263°C; IR(KBr, cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1630(-CH=N-),1095(-C-S-); ^{1}HNMR(δ ppm):3.85 (1H, s, OH),6.4-8.86 (multiplet,aromatic+ CH of CH=N protons),^{13} CNMR (δ ppm): 130-150 (Triazolo-thiadiazole),115-129 (Benzene), 153(-CH=N-), Anal.Calcd.for $C_{22}H_{15}N_5SO$; C,66.4; H,3.7; N,17.6; S,8.0.Found: C,66.1; H,3.6; N,17.4;S,7.9 Yield, 67%.

4-Methyl benzylidine-[3,6-(di phenyl)-[1,2,4]triazolo[3,4-b][1,3,4]thiadiazole].(4e): M.P.:253°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1630(-CH=N-), 1095(-C-S), 1370(-CH_3); ^{1}HNMR(δ, ppm):2.5(3H, s, -CH_3),6.4-8.86 (multiplet, aromatic + CH of CH=N protons),^{13} CNMR(δ ppm): 130-150(Triazolo-thiadiazole),115-129(Benzene), 153(-CH=N-),20.9(CH_3), Anal.Calcd. for $C_{23}H_{17}N_5S$; C,69.8; H,4.3; N,17.7; S,8.1.Found: C,69.5; H,4.2; N,17.5; S,7.9 Yield, 64%.

3, 4-Methylenedioxy benzylidine-[3,6-(di phenyl)-[1, 2, 4]triazolo[3,4-b][1,3,4]thiadiazole].(4f): M.P.: 225°C; IR(KBr,cm^{-1}): 3030-3080 (Aromatic C-H Stretching), 1630 (-CH=N-),1095(-C-S-), 1450(-CH_2); ^{1}HNMR(δ, ppm): 5.9 (2H, singlet, -O-CH_2-O-), 6.4-8.86 (multiplet, aromatic + CH of CH=N protons),^{13} CNMR(δ, ppm): 130-150(Triazolo-thiadiazole).115-129(Benzene), 153(-CH=N-),91.3(2H, singlet, -O-CH_2-O-), Anal.Calcd.for $C_{23}H_{15}N_5O_2S$; C,64.9; H,3.; 16.4;S,7.5. Found: C,64.7H, 3.4; N, 16.3; S,7.4 Yield, 64%.

4-Hydroxy-3-methoxy benzylidine [3,6-(di phenyl)-[1,2,4]triazolo[3,4-b][1,3,4]thiadiazole].(4g): M.P.:235°C; IR(KBr, cm^{-1}):3030-3080 (Aromatic C-H Stretching), 1630 (-CH=N-),1095(-C-S-),1200(Ar-OCH_3) 3370(-OH); ^{1}HNMR(δ, ppm): 6.4-8.86 (multiplet, aromatic + CH of CH=N protons) 3.85, (1H, s, OH), 3.85(3H,S,-OCH_3),^{13} CNMR(δ, ppm): 130-150(Triazolo-thiadiazole), 115-129(Benzene),153(-CH=N-), 56.3(OCH_3), Anal.Calcd. for $C_{23}H_{17}N_5O_2S$;C,64.6;H,3.9;N,16.3;S,7.4.Found: C,64.4H,3.7;N,16.1;S,7.2Yield,61%

3, 4-Diethoxy benzylidine –[3, 6-(di phenyl)-[1, 2, 4] triazolo[3,4-b][1,3,4]thiadiazole].(4h): M.P:238°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1630(-CH=N-),1095(-C-S-), 2028(CH_2); ^{1}HNMR(δ, ppm): 6.4-8.86 (multiplet,aromatic+ CHof CH=N protons) 4.0, (4H, q, 2CH_2),1.33(6H, t, 2CH_3)^{13} CNMR(δ, ppm): 130-150 (Triazolo-thiadiazole),115-129(Benzene),153(-CH=N-),64.4(CH_2),14.3(CH_3),Anal.Calcd.for $C_{26}H_{23}N_5O_2S$;C,66.5;H,4.9;N,14.9;S,6.8. Found: C,66.3; H, 4.8; N,14.8; S, 6.7Yield, 60%.

Preparation of compounds (5a-h)

Preparation of 3-chloro-1-[3, 6-(diphenyl) [1, 2, 4] triazolo[3, 4-b][1, 3, 4]thiadiazole]-4-Substituted-aryl-azetidin-2-ones (5 a-h): A mixture of Schiff bases (4a-h) (0.002 mole) and triethyl amine (TEA) (0.004 mole) was dissolved in 1,4-dioxane (50 ml), cooled and stirred. To this well-stirred cooled solution, chloro acetyl chloride (0.004 moles) was added drop wise within a period of 30 minutes. The reaction mixture was then stirred for an additional 3 hours and left at room temperature for 48 hours. The resultant mixture was concentrated, cooled, poured into ice-cold water and then air-dried. The product thus obtained was purified by column chromatography over silica gel using 30% ethyl acetate: 70% benzene as eluent. Recrystallization from ether/n-hexane gave 2-azetidinones (5a-h) which were obtained in 55-70% yield.

3-Chloro- [1-(3,6-(diphenyl) [1,2,4]triazolo[3,4-b][1,3,4]thiadiazole)]-4-phenyl-azetidin-2-one (5a): M.P.: 190-192°C; IR(KBr, cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1697 (β Lactum (C=O)); ^{1}HNMR(δ, ppm): 6.14-

7.90 (15H,m,Aromatic) 10.8 (1H of C3H of β-lactam), ^{13}CMR (δ, ppm):169(C=O), 136-145 (Triazole+thiadiazole), 143,48,156 (β-Lactum), Anal.Calcd.for $C_{24}H_{16}N_5OSCl$; C,62.9; H,3.5;N,15.3;S,7.0;Cl,7.7.Found: C,62.7; H,3.4; N,15.1; S,7.0;Cl,7.4.Yield, 60%.

3-Chloro-[1-(3,6-(diphenyl) [1,2,4]triazolo[3,4-b][1,3,4]thiadiazole)]-4-(4-methoxy phenyl)-azetidin-2-one(5b): M.P.: 189-191°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1697 [β Lactum (C=O)], 1200 (Aryl-alkyl ether); ^{1}HNMR(δ, ppm): 6.14-7.90 (14H,m,Aromatic) 10.4 (1H of C3H of β-lactam),4.3 (3H,s,-OCH_3); ^{13}CMR (ä,ppm):169(C=O), 136-145 (Triazole+thiadiazole), 143,48,156 (β-Lactum), 46 (-OCH_3); Anal.Calcd.for $C_{25}H_{18}N_5O_2SCl$; C,61.5;H,3.6;N,14.3; S,6.5;Cl,7.2.Found: C,61.3; H,3.4;N,14.1; S,6.4;Cl, 7.1.Yield, 68%.

3-Chloro-[1-(3,6-(diphenyl) [1,2,4]triazolo[3, 4-b] [1,3,4]thiadiazole] -4-(4-hydroxyphenyl)-azetidin-2-one(5c): M.P.: 185-186°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1697 [β Lactum (C=O)]; ^{1}HNMR (δ pp 0.8 (1H of C3H of δ-lactam),3.6(-OH);^{13}CMR (δ,ppm):169(C=O), 136-145 (Triazole+thiadiazole), 143,48,156 (β-Lactum), 119(-C-O-H); Anal.Calcd.for $C_{24}H_{16}N_5O_2SCl$;C,60.8; H,3.3;N,14.7; S,6.7;Cl,7.4.Found: C,60.7; H,3.3;N,14.5; S,6.6; Cl,7.3.Yield, 53%.

3-Chloro-[1-(3,6-(diphenyl) [1,2,4] triazolo[3,4-b][1, 3, 4] thiadiazole]-4-(2-hydroxyphenyl)-azetidin-2-one (5d): M.P.: 189-190°C; IR(KBr, cm^{-1}): 3030-3080 (Aromatic C-H Stretching), 1697 [β Lactum (C=O)]; ^{1}HNMR(δ, ppm): 6.14-7.90 (14H,m,Aromatic) 10.8 (1H of C3H of β-lactam),3.9(-OH) ;^{13}CMR (δ, ppm):169(C=O), 136-145 (Triazole+thiadiazole),143,48,156 (β-Lactum),135(-C-O-H); Anal.Calcd.for $C_{24}H_{16}N_5O_2SCl$; C,60.8; H,3.3; N,14.7; S,6.7; Cl,7.4.Found: C,60.5; H,3.0; N,14.5; S,6.5; Cl,7.3.Yield, 55%.

3-Chloro-[1-(3,6-(diphenyl) [1,2,4]triazolo[3,4-b][1,3,4]thiadiazole)]-4-(methyl phenyl)-azetidin-2-one(5e): M.P.: 194-195°C; IR(KBr,cm^{-1}): 3030-3080 (Aromatic C-H Stretching), 1697 [β Lactum (C=O)],1370(-CH_3); ^{1}HNMR(δ, ppm): 6.14-7.90 (14H, m, Aromatic) 10.4 (1H of C3H of β-lactam), 2.1 (3H of CH_3); ^{13}CMR (ä,ppm):169(C=O), 136-145 (Triazole+thiadiazole), 143,48,156 (â-Lactum); Anal.Calcd.For $C_{25}H_{18}N_5OSCl$; C,63.6; H,3.8; N,14.8;S,6.7; Cl,7.5.Found: C,63.4; H,3.4; N,14.5; S,6.5; Cl,7.3.Yield, 63%.

3-Chloro-[1-(3,6-(diphenyl) [1,2,4]triazolo[3, 4-b][1,3,4]thiadiazole)]-4-(3,4-methylenedioxy phenyl)-azetidin-2-one(5f): M.P.: 162-163°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1697 [β Lactum (C=O)],1200 (Aryl-alkyl ether); ^{1}HNMR(δ, ppm): 6.14-7.90 (14H, m, Aromatic) 10.4 (1H of C3H of β-lactam), 5.8 (2H of -O-CH_2-O-);^{13}CMR (δ, ppm):169(C=O), 136-145 (Triazole+thiadiazole),143,48,156 (β-Lactum), 91 (-O-CH_2-O-); Anal.Calcd.for $C_{25}H_{16}N_5O_3SCl$; C,59.8;H,3.2; N,13.9;S,6.3; Cl,7.0.Found: C,59.7; H,3.2;N,13.7; S, 6.2; Cl,6.8.Yield, 52%.

3-Chloro-[1-(3,6-(diphenyl) [1,2,4]triazolo[3, 4-b][1,3,4] thiadiazole)] -4(4-hydroxy-3-methoxy phenyl)-azetidin-2-one(5g): M.P.: 198-199°C; IR(KBr,cm^{-1}): 3030-3080(Aromatic C-H Stretching), 1697 (β Lactum (C=O)), 1200 (Aryl-alkyl ether); ^{1}HNMR(δ ppm): 6.14-7.90 (14H, m,Aromatic) 10.4 (1H of C3H of β-lactam),4.3 (3H,s,-OCH_3), 3.36(1H,s, OH) ;^{13}CMR (δ, ppm):169(C=O), 136-145 (Triazole+thiadiazole), 143,48,156 (δ-Lactum), 46 (-OCH_3),135(-C OH); Anal.Calcd.for $C_{25}H_{18}N_5O_3SCl$; C,59.5;H,3.5;N,13.9;S,6.3;Cl,7.0.Found: C,59.4;H,3.4;N,13.8;S,6.2;Cl,7.0.Yield, 50%.

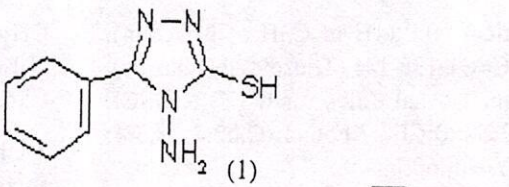
3-Chloro-[1-(3,6-(diphenyl) [1, 2, 4]triazolo[3, 4-b][1,3,4]thiadiazole)]-4-(3, 4-diethoxyphenyl) - azetidin-2-one(5h): M.P.: 180-181°C; IR(KBr,cm^{-1}): 3030-3080 (Aromatic C-H Stretching), 1697 [β Lactum (C=O)], 1200 (Aryl-alkyl ether); ^{1}HNMR(δ, ppm): 6.14-7.90 (14H, m, Aromatic) 10.4 (1H of C3H of β-lactam),2.9 (4H,q,-$2CH_2$), 2.5(6H,d, -$2CH_3$); ^{13}CMR (δ, ppm):169(C=O), 136-145 (Triazole + thiadiazole), 143,48,156 (β-Lactum),135(-C-OH); Anal.Calcd. for $C_{28}H_{24}N_5O_3SCl$; C,61.5; H,4.4; N,12.8; S, 5.8; Cl,6.5.Found: C,61.5; H,4.4; N,12.7; S,5.7; Cl, 6.3.Yield, 51%.

Results and Discussion

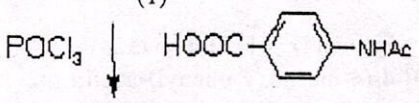
Preparation of 4-amino-5-phenyl-4H-1,2,4-triazole-3-thiol (1) of potassium-benzoic acid hydrazide dithiocarbamate reaction with hydrazine hydrate in presence of acetic acid were prepared according to the Radadia[28]. The structure of (1) was established by spectroscopic evidence. The compound (1) was reacted with N-Acetyl-p-amino benzoic acid in the presence of $POCl_3$ to get corresponding 3-(phenyl)-6-(4-N-acetylamino phenyl) [1,2,4]triazolo[3,4-b][1,3,4]thiadiazole (2). It can be hydrolyzed to 3-(phenyl)-6-(4-amino phenyl) [1,2,4]triazolo[3,4-b] [1,3,4] thiadiazole(3) by ethanol/HCl. It is characterized by elemental analysis, IR Spectral studies and NMR Spectral studies. The IR Spectra of the compound (3) show the bands at 3362 cm^{-1} for NH_2 group.

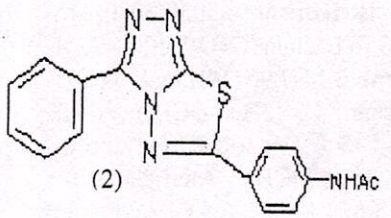
This hydrolyzed compound (3) was reacted with various aromatic aldehydes in the presence of acetic acid to yields Schiff bases[29] (4a-h) which were then characterized by the elemental analysis, IR Spectral studies and NMR Spectral studies. The IR Spectra of Schiff bases show the prominent band at 1630 cm^{-1} for the anils (CH=N) group. These Schiff bases on cyclo condensation reaction with chloro acetyl chloride in the presence of tri ethyl amine afforded 2-Azetidinones (5a-h). The structure of these compounds was confirmed by the elemental analysis, IR Spectral studies and NMR Spectral studies. These compounds show the bands at 1697 cm^{-1} (C=O) of Azetidinones ring[30].

IR, NMR, Pet Ether.

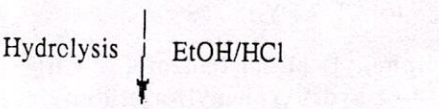


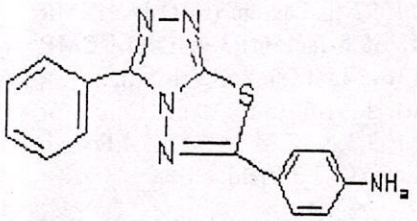
(1)



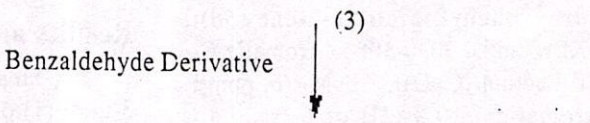


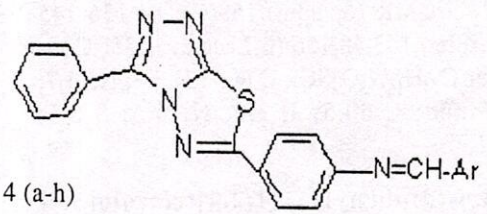
(2)



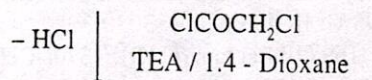


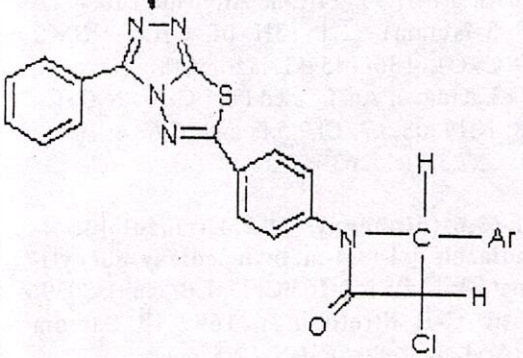
(3)





4 (a-h)





where Ar = a) - phenyl
b) - 4 - methoxy phenyl
c) - 4 - hydroxy phenyl
d) - 2 - hydroxy phenyl
e) - 4 - methyl phenyl
f) - 3, 4 - methylenedioxy phenyl
g) - 4 - hydroxy - 3 - methoxy phenyl
h) - 3, 4-diethoxy phenyl

5 (a-h)

Scheme 1

Table I

Antibacterial Activity and Anti fungal activity of compounds (5 a-h)

Compounds	Antibacterial Activity				Anti fungal activity	
	Zone of Inhibition (in mm)					
	Gram +ve		Gram –ve			
	B. Subtillis	S. Aureus	E. Coli	Ps. Aeruginosa	C. Albicans	A. Niger
5a	9	13	10	11	11	12
5b	15	10	11	8	8	14
5c	11	9	7	8	11	9
5d	13	11	18	15	16	17
5e	19	19	16	21	15	16
5f	19	19	16	21	15	16
5g	14	15	14	13	10	13
5h	14	15	17	22	14	15
Ampicillin	19	15	20	21	-	-
Tetracyclin	21	20	15	18	-	-
DMF	6	5	5	5	-	-
Griseofulvin	-	-	-	-	23	24

Acknowledgement

We are thankful to the Department of Chemistry, Himchandracharya, North Gujarat University, Patan, Gujarat (India) for providing the necessary facilities for the research work.

References

1. Jang B.C., Paik J.H., Kim Sang-pyo, Shin Dong-Hoon, Suh Min-Ho, Park Jong Wook and Suh Seong II, *Cellular Signalling*, **17**, 625 (**2005**)

2. Chekovskaya L.G., Khush E.G. and Rogyllchenko G.K., *Farm.*, **5**, 67 (**1989**)

3. Al Soud Y.A., Al Dweri M.N. and Al Masoudi N.A., *IL Farmaco*, **59**, 775 (**2004**)

4. Reigz D.B., *Chem. Abstr.*, **118**, 59716w (**1993**)

5. Kudari S.M., Beede S.M. and Munera W., *Asian J. Chem.*, **9**, 20 (**1997**)

6. Zitouni G.T., Kalpancykly Z.A., Yyldyz M.T., Chevallet P. and Kaya D., *Eur. J. Med. Chem* (In press)

7. Almasirad A., Tabatabai S.A.,Faizi M., Mehrabi N. and Shafiee A., *Bioorg & Med. Chem. Lett.*, **14**, 6057 (**2004**)

8. Takafumi F., Osamu U., Takeshi K. and Yasushi T., PCT Int. Appl. WO97,11,075; *Chem.Abstr.*, **126**, 293354 (**1997**)

9. Jin Z., Huo A., Liu T. and Fang J., *J.Organometallic Chem.*, **690**, 1226 (**2005**)

10. Garoufalias S.P., Pouli N., Marakos P. and Ladas A.C., *Bioorg & Med. Chem.Lett.*, **13**, 2601 (**2003**)

11. Murthy S., Nagappa V.A.N. and Nargund L.V.G., *Ind. J. Heterocycl. Chem.*, **8**, 23 (**1998**)

12. Shivarama Holla B., Veerendra B., Shivananda M.K. and Poojary Boja, *Eur.J.Med.Chem.*, **38**, 759 (**2003**)

13. Hu C.C. and Wen S.X., *Chin.Chem.Lett.*, **10**, 361 (**1999**)

14. Verma R.S., Bajpai V. and Kapil A., *Ind.J.Heterocycl.Chem.*, **10**, 117 (**1999**)

15. Al-Soud Y.A., Al-Masoudi N.A. and El-Rahman A., *Bioorg & Med.Chem.*, **11**, 1701 (**2003**)

16. Zitouni G.T., Kaplancikli Z.A. and Kilic F.S., *Chem. Abstr.*, **138**, 271613t (**2003**)

17. Walczak K., Gondela A. and Guwinski J., *Eur.J.Med.Chem.*, **39**, 849 (**2004**)

18. Klimeova V., Zahajska L. and Mollmann U., *IL Farmaco*, **59**, 279 (**2004**)

19. Alanile A., Anselm L., Steward L., Thomi S. and Groaning M.D., *Bioorg. & Med. Chem. Lett.*, **14**, 817 (**2004**)

20. Ramesh S., Rajeswari S. and Maruthamuthu S., *Appl.Surface.Sci.*, **229**, 214 (**2004**)

21. Mishra R.K., Tiwari R.K., Srivastava S.K. and Bahel S.C., *J. Ind. Chem. Soc.*, **68**, 110 (**1991**)

22. Hay S.J.B.; Proc.6th Brit.Crop.Prof. Council Insct. Fungic.,

R.M. Patel

597 (1972)

23. AtsuoB., Harahiko M., Yoshikazu O. and Takushi S., *Chem.Abstr.*, **129**, 21656n (**1998**)

24. Mohammad A.and Shalini S., *Ind.J.Chem.*, **37(B)**, 502 (**1998**)

25. Mohan J., Anjaneywill GSRA, Verma P. and Yamini V.S., *Ind.J.Chem.*, **29(B)**, 88 (**1990**)

26. Aboel-Magd A., Khairy Abdei-Wahab M.H. and El-Ezbawy S.R., *Ind. J. Chem.*, **18 (B)**, 467-469 (**1979**)

27. Kumar A., Gurtu S., Agarwal J.C., Sinha J.N., Bhargava K.P. and Shanke K., *J. Ind, Chem, Soc.*, **60**, 608-610 (**1989**)

28. Radadia R.G., Ph.D. Thesis, HNGU, Patan (**2008**)

29. Mamdouh A.M. Taha, *Phosporous, Sulfur and Silicon*, **183**, 2525-2533 (**2008**)

30. Bellamy L. J., The Infrared Spectra of Complex Molecule, John Wiley and Sons, New York (**1954**).

(Received 5th July 2009, revised 30th October 2009, accepted 18th December 2009)