HL ISSN: 2231 – 3087(print) / 2230 – 9632 (Online)
http://heteroletters.org Vol. 3: (1), 2013, 49-56

SYNTHESIS, CHARACTERIZATION AND ANTIMICROBIAL EVALUATION OF PYRIDINE BASED THIAZOLIDINONES

Keerthi Kumar Kodari[#], O. P. Chourasia.

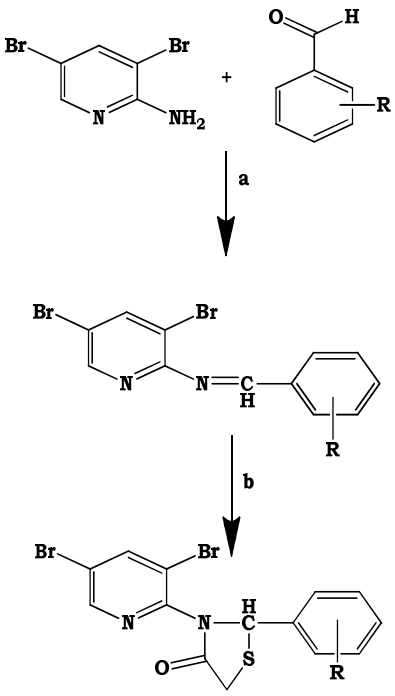
Heterocyclic Research Laboratory, Department of Chemistry,
Dr. H. S. Gour Central University, Sagar, M.P, India-470003.
Tel: +91-7582264989, E-mail: keerthikodari@gmail.com

Abstract
The amino pyridine which has been used as a key material for the present synthesis. Schiff bases participating active role for the formation of thiazolidinones derivatives. For the preparation of these Schiff bases here we have used amino pyridine and different type of aromatic aldehydes. The successfully formed Schiff bases are further reacted with thioglycolic acid in the presence of zinc chloride the title compound was obtained. In addition these resultants were screened for their antimicrobial activity against different bacterial and fungal strains. The synthesized thiazolidinone derivatives were characterized by IR, ^{1}H NMR, ^{13}C NMR and elemental analyses studies.

Keywords
Thiazolidinone, Antimicrobial, Schiff base, Pyridine.

Introduction

It is interesting to study 4-thiazolidinones as one of the main objectives of organic and medicinal chemistry, these heterocyclic moieties being paid unique awareness as they belong to a class of compounds with proven utility in organic and medicinal chemistry. The design, synthesis and production of these molecules having value as human therapeutic agents. A number of protocols for the synthesis of 4-thiazolidinones are available in the literature, for this Schiff bases have played a vital role for the formation of 4-thiazolidinones. 4-Thiazolidinones are derivatives of thiazolidine with a carbonyl group in the 4-position as reported with several biological[I, II] aspects together with antibacterial[III-XIX], antifungal[X, XI], anti-inflammatory[XII, XIII], antitumor[XIV, XV], anti-HIV[XVI] anticonvulsant[XVII], antitubercular[XVIII] activity. In the present study we have reported 3-(3,5-dibromopyridin-2-yl)-2-phenylthiazolidin-4-one as a good anti microbial agent. Due to the important position of pyridine and its derivatives in the field of organic and medicinal chemistry. Pyridine and its derivatives are widely distributed in nature and have been known to exhibit broad spectrum of biological activities. Based on the previous findings it was thought worthwhile to synthesize new bioactive pyridine containing thiazolidinone derivatives.



Scheme I

Reaction conditions: a) Ar-CHO, b) Thioglycolic acid, Zinc chloride.

3a-4-OH-3-OCH_3; 3b-4-OCH_3; 3c-4-NO_2; 3d-2-OH; 3e-4-OH; 3f-4-Br; 3g-3,4,5-Trimethoxy; 3h-2-OH-3-OCH_3; 3i-4-Cl; 3j- H; 3k-2-NO_2; 3l- $N(CH3)_2$; 3m-3-NO_2.

Results and Discussion

In the present study, a series of new heterocyclic moieties have been synthesized and describes the path used for the preparation of target compounds. The structures of the newly synthesized heterocyclic compounds have been confirmed by IR, ^{1}H-NMR and ^{13}C-NMR spectral data studies.

A series of new heterocyclic moieties have been synthesized. **Scheme - I** describes the path used for the preparation of target compounds. In order to synthesize a new series of condensed pyridine containing thiazolidinone derivatives, substituted amino pyridines, different types of aromatic aldehydes and thioglycolic acid have been used. The substituted amino pyridine on treatment with different type of aromatic aldehyde gave Schiff bases. These Schiff bases on treatment with thioglycolic acid, have resulted in to, the biologically active thiazolidinones. This outcome was confirmed by IR (KBr) cm^{-1}: 3031.55 (Ar-H), 3066.42 (C-H str in ring), 1713.55(C=O) 1544.82(C=N), 695.27 (C-S), 1275.37 (C-N). H^{1} NMR, In the ^{1}H NMR spectra of compounds **3(a-m)** recorded 7.01-7.28 (m, 5H, Ar-H), 8.56 (s, 1H, N-CH), 8.38 (s, 1H, CH) 5.28 (s, 1H, N-CH-S), 3.30 (s, 2H, CH_2).

The^{13}C NMR spectrum of compounds **3(a-m)** recovered in DMSO-d6, the prominent signals corresponding to the carbons of condensed thiazolidinone derivatives. In all compounds observed nearly at 169.4, 150.8, 147.47, 118.1, 112.9, 142.7, 130.2, 128.4, 126.5, 125.8, 35.5. ppm. are of further proof to substantiate the evidence, regarding the determination of their

structures. The physical data and elemental analyses of the synthesized derivatives have also be shown in Table-I

Table I. Physical And Analytical Data Of The Synthesized Isoxazoline **(3a-m)** Derivatives.									
Comp. code	Formula	M.P(ºc)	Yield(%)	Elemental Analysis (calc. / found) (%)					
				C		H		N	
3a	$C_{15}H_{12}Br_2N_2O_3S$	142	61	39.15	39.04	2.63	2.65	6.09	6.01
3b	$C_{15}H_{12}Br_2N_2O_2S$	134	58	40.56	40.39	2.72	2.68	6.31	6.38
3c	$C_{14}H_9Br_2N_3O_3S$	184	76	36.62	36.58	1.98	1.91	9.15	9.1
3d	$C_{14}H_{10}Br_2N_2O_2S$	135	60	39.09	38.94	2.34	2.36	6.51	6.44
3e	$C_{14}H_{10}Br_2N_2O_2S$	138	61	39.09	39.01	2.34	2.28	6.51	6.43
3f	$C_{14}H_9Br_3N_2OS$	158	63	34.11	34.03	1.84	1.78	5.68	5.62
3g	$C_{17}H_{16}Br_2N_2O_4S$	159	62	40.50	40.44	3.20	3.11	5.68	5.56
3h	$C_{15}H_{12}Br_2N_2O_3S$	147	65	39.15	39.05	2.63	2.68	6.09	6.01
3i	$C_{14}H_9Br_2ClN_2OS$	161	65	37.49	37.44	2.02	1.95	6.25	6.19
3j	$C_{14}H_{10}Br_2N_2OS$	129	57	40.60	40.51	2.43	2.37	6.76	6.71
3k	$C_{14}H_9Br_2N_3O_3S$	170	69	36.62	36.65	1.98	1.92	9.15	9.06
3l	$C_{16}H_{15}Br_2N_3OS$	156	68	42.03	41.94	3.31	3.26	9.19	9.14
3m	$C_{14}H_9Br_2N_3O_3S$	173	71	36.62	36.56	1.98	1.92	9.15	9.11

The synthesized heterocyclic moieties have been screened for both antibacterial and antifungal activities. Results have been depicted in **Table II**, the most of the screened derivatives have shown pretentiously variable inhibitory effects on the growth of tested bacterial and fungal strains. The synthesized pyridine containing thiazolidinones derivatives exhibited prospective antibacterial and antifungal activity on evaluation with the standards (Streptomycin & Treflucan), against *Bacillus subtilis,* the synthesized thiazolidinones derivatives 3c, 3i, 3k, 3m have shown good activity and the moieties 3c, 3m have shown promising activity on *Bacillus thuringiensis*, the synthesized compounds 3k, 3m were potent against *Escricha coli* and 3c, 3k, 3m have shown promosing activity against *Pseudomonus aeruginosa*. On overall appraisal of the antimicrobial data, the nitro and chloro substituted derivatives were highly potent against the selected bacterial strains on rest of all other moieties. Antifungal activity of all the synthesized derivatives 3b, 3h, have been shown good antifungal activity against *Aspergillus fumigates*. the compounds 3b, 3d, 3e, 3h are active against *Candida albicans* and the compounds 3e, 3h exhibited good activity against *F. oxysporum*. The moiety '3h' (2-OH-3-OCH_3) is highly potent against all the antifungal strains, in general evaluation, the outcome of the derivatives 3b, 3e, 3h strong against selected bacteria. the results have been depicted in **Table II**. The remaining compounds have also shown moderate to good antimicrobial activity against all the strains employed in the present investigation.

Table II Antibacterial And Antifungal Activities of Synthesized compounds **(3a-m).** MIC (μg/mL)								
		Antibacterial activity				Antifungal activity		
Comp.code	R	B.subt	B.thur	E.coli	P.aeru	A.fumig	F.oxys	C.albica
3a	4-OH-3-OCH_3	12.5	50	-	>50	-	6.25	-
3b	4-OCH_3	50	-	-	>50	>3.125	6.25	>3.125
3c	4-NO_2	3.125	>3.125	6.25	3.125	-	50	-
3d	2-OH	>50	-	-	-	6.25	6.25	3.125
3e	4-OH	-	50	50	-	6.25	>3.125	3.125
3f	4-Br	6.25	>6.125	>6.25	6.25	25	-	-
3g	3,4,5-Trimethoxy	50	-	>50	-	12.5	6.25	6.25
3h	2-OH-3-OCH_3	-	50	-	>25	>3.125	3.125	>3.125
3i	4-Cl	>3.125	6.25	>6.25	>6.25	>25	-	50
3j	H	-	-	50	-	-	-	>50
3k	2-NO_2	>3.125	6.25	3.125	3.125	-	>50	-
3l	$N(CH3)_2$	50	>50	-	-	12.5	6.25	6.25
3m	3-NO_2	>3.125	>3.125	3.25	>3.125	25	-	-
Streptomycin	-	3.125	6.25	6.25	6.25	-	-	-
Treflucan	-	-	-	-	-	3.125	3.125	3.125
B. subtilis (MTCC 441), *B. thuringiensis* (MTCC No: 4714), *E. coli* (MTCC 443), *P. aeruginosa* (MTCC 1688), and the following fungal strains *A. fumigatus* (MTCC 3008), *F. oxysporum* (MTCC No: 7392), *C. albicans* (MTCC 227).								

Experimental

Material and Methods :

All melting points were measured on open capillary method and are uncorrected. IR spectra were recorded for KBr disc on Schimadzu-8400 FT IR spectrophotometer. ^{1}H NMR and ^{13}C NMR spectra were measured on a Bruker Avance II 400 spectrometer, operating at 400, 100.6 MH_z respectively. Chemical shifts (δ) are reported in ppm and TMS as an internal standard. Reactions were monitored by thin layer chromatography (TLC) on silica gel, plates were visualized with ultraviolet light and iodine.

Synthesis of N-benzylidene-3,5-dibromopyridin-2-amine.(1)

To a stirred solution of 3,5-dibromo,2-aminopyridine (0.01mole) in ethanol, and (0.01mole) of aromatic aldehyde was added to it, the reaction mixture was stirred for 5 h with continuous refluxing. The progress of the reaction was checked by TLC. After completion of the reaction, the reaction mixture was cooled and then poured it in to crushed ice finally the solid obtained was filtered and recrystallized.

3-(3,5-dibromopyridin-2-yl)-2-phenylthiazolidin-4-one. (2)

To a cooled mixture of compound N-benzylidene-3,5-dibromopyridin-2-amine 0.01mol and anhydrous ZnCl2 (0.02mol) in DMF 50ml, thioglycolic acid (0.02mol) was added drop wise with stirring at ambient temperature and refluxed for 12 h. The reaction mixture was filtered, washed with water and poured into cooled water. The resulting products were recrystallized. The progress of the reaction was checked by TLC. In this way all the pyridine containing thiazolidinone derivatives **3(a-m)** have been synthesized.

3-(3,5-dibromopyridin-2-yl)-2-(4-hydroxy-3-methoxyphenyl)thiazolidin-4-one. (3a)

IR (KBr) cm^{-1}: 3043.26 (Ar-H), 3059.13 (C-H str in ring), 1716.21 (C=O), 3381.93(O-H str), 2947.86 (C-H in CH_3), 1543.27(C=N), 1229.06 (C-O-C str), 698.17 (C-S), 1263.61 (C-N), 2886.17 (CH str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.83-6.9 (m, 3H, Ar-H), 8.39 (s, 1H, N-CH), 8.20 (s, 1H, CH), 5.58 (s, 1H, N-CH-S), 5.01 (s,1H, OH), 3.41(s, 2H, CH_2), 3.23 (s, 3H, OCH_3); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 171.3(C=O), 151.3, 145.8, 115.8, 110.2, 143.1, 146.7, 141.3, 133.1, 123.06, 118.1, 117, 54.8, 39.1.

3-(3,5-dibromopyridin-2-yl)-2-(4-methoxyphenyl)thiazolidin-4-one. (3b)

IR (KBr) cm^{-1}: 3049.20 (Ar-H), 3064.99 (C-H str in ring), 1716.70 (C=O), 2943.65 (C-H in CH_3), 1552.29(C=N), 1236.77 (C-O-C str), 693.58 (C-S), 1270.42 (C-N), 2891.15 (CH str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.71-6.82 (m, 4H, Ar-H), 8.41 (s, 1H, N-CH), 8.28 (s, 1H, CH), 5.23 (s, 1H, N-CH-S), 3.42(s, 2H, CH_2), 3.18 (s, 3H, OCH_3); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 170.8, 151.3, 145.8, 115.8, 110.3, 142.3, 146.8, 118.3, 119.1, 123.6, 130.7, 58.1, 35.1.

3-(3,5-dibromopyridin-2-yl)-2-(4-nitrophenyl)thiazolidin-4-one. (3c)

IR (KBr) cm^{-1}: 3029.43 (Ar-H), 3061.28 (C-H str in ring), 1723.18 (C=O), 1545.19(C=N), 691.16 (C-S), 1263.73 (C-N), 1528.76 (N-O str), 1740.23 (C=O); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 7.01-7.43 (m, 4H, Ar-H), 8.39 (s, 1H, N-CH), 8.27 (s, 1H, CH), 5.09 (s, 1H, N-CH-S), 3.33(s, 2H, CH_2); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 170.8, 151.3, 145.8, 115.7, 109.8, 140.8, 148.1, 123.2, 128.7, 138.1, 131.8, 115.9, 33.2.

3-(3,5-dibromopyridin-2-yl)-2-(2-hydroxyphenyl)thiazolidin-4-one. (3d)

IR (KBr) cm^{-1}: 3029.16 (Ar-H), 3058.33 (C-H str in ring), 1546.42 (C=N), 701.18 (C-S), 1268.16 (C-N), 2891.49(C-H str CH_2), 3398.53 (O-H str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.87-7.17 (m, 4H, Ar-H), 8.41 (s, 1H, N-CH), 8.28(s, 1H, CH), 5.27 (s, 1H, N-CH-S), 3.29 (s, 2H, CH_2), 5.01 (s, 1H, O-H); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 168.1, 151.5, 147.1, 117.1, 111.3, 141.3, 153.0, 130.5, 122.5, 118.3, 132.01, 35.1.

3-(3,5-dibromopyridin-2-yl)-2-(4-hydroxyphenyl)thiazolidin-4-one. (3e)

IR (KBr) cm^{-1}: 3030.34 (Ar-H), 3058.12 (C-H str in ring), 1546.18(C=N), 703.55 (C-S), 1270.48 (C-N), 2891.25(C-H str CH_2), 3394.61 (O-H str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.87-7.18 (m, 4H, Ar-H), 8.43 (s, 1H, N-CH), 5.27 (s, 1H, N-CH-S), 8.25(s, 1H, CH), 3.29 (s, 2H, CH_2), 4.96 (s, 1H, O-H); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 167.5, 151.2, 145.8, 117.4, 111.1, 141.9, 152.6, 131.2, 122.6, 118.4, 132.01, 34.5.

2-(4-bromophenyl)-3-(3,5-dibromopyridin-2-yl)thiazolidin-4-one. (3f)

IR (KBr) cm^{-1}: 3046.19 (Ar-H), 3068.03 (C-H str in ring), 1715.29(C=O) 1546.34(C=N), 700.68 (C-S), 1271.27 (C-N), 2883.97(C-H str CH_2); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 7.2-7.51 (m, 4H, Ar-H), 8.39 (s, 1H, N-CH), 8.30 (s, 1H, CH) 5.19 (s, 1H, N-CH-S), 3.31 (s, 2H, CH_2); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 169.8, 152.7, 148.3, 117.3, 112.1, 144.0, 138.1, 127.6, 129.4, 125.1, 34.7.

3-(3,5-dibromopyridin-2-yl)-2-(3,4,5-trimethoxyphenyl)thiazolidin-4-one. (3g)
IR (KBr) cm^{-1}: 3049.20 (Ar-H), 3064.99 (C-H str in ring), 1716.70(C=O) 1552.20(C=N), 693.58 (C-S), 1290.42 (C-N), 2887.15(C-H str CH_2), 2943.65(C-H str CH_3), 1226.77(C-O-C); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.81 (m, 4H, Ar-H), 8.38 (s, 1H, N-CH), 8.28 (s, 1H, CH) 5.19 (s, 1H, N-CH-S), 3.28 (s, 2H, CH_2), 3.71(s, 6H, OCH_3), 3.58(s, 3H, OCH_3); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 170.1, 151.9, 148.01, 117.3, 112.3, 140.9, 159.8, 129.9, 113.8, 131.8, 32.1, 54.1.

3-(3,5-dibromopyridin-2-yl)-2-(2-hydroxy-3-methoxyphenyl)thiazolidin-4one. (3h)
IR (KBr) cm^{-1}: 3050.34 (Ar-H), 3059.25 (C-H str in ring), 1714.84 (C=O), 3380.12(O-H str), 2947.29 (C-H in CH_3), 1541.21(C=N), 1231.53 (C-O-C str), 699.25 (C-S), 1265.18 (C-N), 2892.36 (CH str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.85-7.1 (m, 3H, Ar-H), 8.41 (s, 1H, N-CH), 8.18 (s, 1H, CH), 5.61 (s, 1H, N-CH-S), 5.12 (s,1H, OH), 3.48(s, 2H, CH_2), 3.25 (s, 3H, OCH_3); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 171.8, 155.6, 141.2, 113.5, 110.8, 144.5, 147.5, 141.8, 133.7, 121.5, 118.1, 116.5, 57.2, 38.6.

2-(4-chlorophenyl)-3-(3,5-dibromopyridin-2-yl)thiazolidin-4-one. (3i)
IR (KBr) cm^{-1}: 3029.51 (Ar-H), 3061.57 (C-H str in ring), 1711.03(C=O) 1541.27(C=N), 693.16 (C-S), 1273.16 (C-N), 1088.91(C-Cl str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 7.22-7.34 (m, 4H, Ar-H), 8.91 (s, 1H, N-CH), 8.56 (s, 1H, CH) 5.28 (s, 1H, N-CH-S), 3.26 (s, 2H, CH_2); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 169.4, 150.8, 147.47, 118.1, 112.9, 142.7, 135.1, 131.7, 129.3, 128.8, 126.5, 33.1.

3-(3,5-dibromopyridin-2-yl)-2-phenylthiazolidin-4-one . (3j)
IR (KBr) cm^{-1}: 3031.55 (Ar-H), 3066.42 (C-H str in ring), 1713.55(C=O) 1544.82(C=N), 695.27 (C-S), 1275.37 (C-N); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 7.01-7.28 (m, 5H, Ar-H), 8.56 (s, 1H, N-CH), 8.38 (s, 1H, CH) 5.28 (s, 1H, N-CH-S), 3.30 (s, 2H, CH_2); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 169.4, 150.8, 147.47, 118.1, 112.9, 142.7, 130.2, 128.4, 126.5, 125.8, 35.5.

3-(3,5-dibromopyridin-2-yl)-2-(2-nitrophenyl)thiazolidin-4-one. (3k)
IR (KBr) cm^{-1}: 3029.21 (Ar-H), 3065.48 (C-H str in ring), 1726.53 (C=O), 1547.38(C=N), 697.15 (C-S), 1265.61 (C-N), 1527.68 (N-O str), 1742.30 (C=O); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 7.03-7.41 (m, 4H, Ar-H), 8.40 (s, 1H, N-CH), 8.25 (s, 1H, CH), 5.11 (s, 1H, N-CH-S), 3.35(s, 2H, CH_2); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 171.6, 151.8, 144.3, 116.2, 109.4141.1 148.5, 123.2, 128.4, 138.3, 131.8, 118.1, 33.8.

3-(3,5-dibromopyridin-2-yl)-2-(4-dimethylamino)thiazolidin-4-one. (3l)
IR (KBr) cm^{-1}: 3030.53 (Ar-H), 3068.41 (C-H str in ring), 1728.71 (C=O), 1548.31(C=N), 694.96 (C-S), 1265.61 (C-N), 1740.18 (C=O); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 6.98-7.21 (m, 4H, Ar-H), 8.51 (s, 1H, N-CH), 8.42 (s, 1H, CH), 5.17 (s, 1H, N-CH-S), 3.17(s, 2H, CH_2), 2.91(s, 6H, $N9CH_3)_2$; ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 169.8, 152.3, 146.5, 119.5, 112.5, 141.9, 138.7, 133.2, 128.1, 127.8, 126.5, 32.9.

3-(3,5-dibromopyridin-2-yl)-2-(3-nitrophenyl)thiazolidin-4-one. (3m)
IR (KBr) cm^{-1}: 3032.20 (Ar-H), 3064.99 (C-H str in ring), 1716.70 (C=O), 2967.61 (C-H in CH_3), 1558.54(C=N), 1531.54 (N-O str), 693.56 (C-S), 1251.84 (C-N), 2889.21 (CH str); ^{1}H NMR (400MHz, DMSO-d_6) δ ppm: 7.06-7.47 (m, 4H, Ar-H), 8.41 (s, 1H, N-CH), 8.30 (s, 1H,

CH), 5.07 (s, 1H, N-CH-S), 3.27(s, 2H, CH_2); ^{13}C NMR (100MHz, DMSO-d_6) δ ppm: 172.1, 153.5, 144.6, 115.2, 110.6, 140.4, 147.5, 122.6, 128.4, 138.7, 132.1, 115.4, 34.5.

Antimicrobial Studies Procedure

The newly synthesized derivatives 3a-m have been screened for their anti bacterial and antifungal activity against the following bacterial strains were used *E. coli*, *B. subtilis*, *B. thuringiensis*, *P. aeruginosa* and *F. oxysporum*, *C. albicans*, *A. fumigatus* fungal strains were used, this activity was determined by agar diffusion method. The compounds were dissolved in DMSO at concentration 1 mg ml^{-1}. The antibacterial and antifungal activities of each compound were compared with Streptomycin and Treflucan respectively as the standard drugs. The results were recorded for each tested compound as the average diameter of inhibition zones (IZ) of bacterial or fungal growth around the discs in mm. The minimum inhibitory concentration (MIC) measurement was shown significant growth inhibition zones (> 10 mm) using twofold serial dilution method.

Conclusion

The synthesized pyridine containing thiazolidinones have been obtained with appreciable yields. Some of thiazolidinone derivatives have shown good antimicrobial activity and the structures of all the synthesized heterocyclic derivatives have been confirmed on the basis of IR, ^1H NMR and ^{13}C NMR spectral data studies.

Acknowledgements

The authors are grateful to the Head, Department of Chemistry, Dr. H. S. Gour University, Sagar for providing necessary facilities to carry out present work. We are also thankful to the Head Department of Botany for providing antimicrobial activity facilities. We are also grateful to the Director, SAIF, Punjab University for assisting to collect spectral data.

References

I. S.G. Kucukguzel, E.E. Oruc, R. Sevim, S. Fikrettin, O. Ahmet, Eur. J. Med. Chem. 37. 197 **(2002)**.
II. V. Amit, S.K. Saraf, Eur. J. Med. Chem. 43, 897 **(2008)**.
III. N.B. Patel, F. M. Shaikh, Saudi Pharmaceutical Journal. 18, 129 **(2010)**.
IV. P.M. Ronad, M.N. Noolvi, S. Sapkal, S. Dharbhamulla, V.S. Maddi, Eur. J. Med. Chem. 45, 85(**2010**).
V. A. Deep, S. Jain, P.C Sharma, S.K. Mittal, P. Phogat, M. Malhotra, Arabian Journal of Chemistry. (in press), XXX, XXX **(2011)**.
VI. V.S. Palekar, A.J. Damle, S.R. Shukla, Eur. J. Med. Chem. 44, 5112 **(2009)**.
VII. C.V. Kavitha, Basappa, S.N. Swamy, K. Mantelingu, S. Doreswamy, M.A. Sridhar, J. S Prasad, K.S. Rangappa, Bioorg. Med. Chem. 14, 2290 **(2006)**.
VIII. C.G. Bonde, N.J. Gaikwad, Bioorg. Med. Chem. 12, 2151**(2004).**
IX. S. Bondock, W. Khalifa, A.A. Fadda, Eur. J. Med. Chem. 42, 948 **(2007)**.
X. R. Sharma, D. P. Nagda, G.L. Talesara, Arkivoc. (i), 1 **(2006)**.
XI. K. Omar, A. Geronikaki, P. Zoumpoulakis, C. Camoutsis, M. Sokovic, A. Ciric, J. Glamoclija, Bioorg. Med. Chem. 18, 426 **(2010)**.
XII. B. Goel, T. Ram, R. Tyagi, E. Bansal, A. Kumar, D. Mukherjee, J.N. Sinha, Eur. J. Med.

Chem. 34, 265 **(1999)**.
XIII. S.K. Bhati, A. Kumar, Eur. J. Med. Chem. 43, 2323 **(2008)**.
XIV. M.M. Kamel, H.I. Ali, M.M. Anwar, N.A. Mohamed, A.M. Soliman., Eur. J. Med. Chem. 45, 572 **(2010)**.
XV. M. Paresh, K.K. Narang, J. Sci. Ind. Res. 64, 585 **(2005)**.
XVI. R.K. Rawal, R. Tripathi, S.B. Katti, C. Pannecouque, D.C. Erik, Eur. J. Med. Chem. 43, 2800 **(2008)**.
XVII. Archana, V.K. Srivastava, A. Kumar, Eur. J. Med. Chem. 37, 873 **(2002)**.
XVIII. R.H. Mizzonai, P.C. Eisman, J. Am. Chem. Soc. 3471 **(1958)**.

Received on October12,2012.