IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(E): 2321-8851; ISSN(P): 2347-4580
Vol. 2, Issue 8, Aug 2014, 11-18

A MICROWAVE PROMOTED ENVIRONMENTALLY BENIGN SYNTHESIS AND SPECTROSCOPIC INVESTIGATION OF NOVEL SCHIFF BASE COMPLEXES

T. N. CHHOWALA[1] & K. R. DESAI[2]

[1]Department of Chemistry, Veer Narmad South Gujarat University, Surat, Gujarat, India

[2]Department of Chemistry, Uka Tarsadia University, Surat, Gujarat, India

ABSTRACT

A novel series of transition metal complexes of Cu, Ni, Mn, Cd, Hg and Co have synthesized from Schiff bases (SB_1 and SB_2) and derived from aryl aldehydes and 5-(3-Bromo-4-methoxyphenyl)-4-{[substitutedphenylmethylidene] amino}-4H-1,2,4-triazole-3-thiol by conventional and microwave promoted method. The molecular formulae of the synthesized compounds were assigned on the basis of elemental analysis while the structures were proposed on the basis of FT IR and ^{1}H NMR spectroscopy. These compounds were screened for *in vitro* antibacterial activity against three pathogenic strains. Preliminary results revealed that some of the synthesized metal complexes showed promising antibacterial activity.

KEYWORDS: Schiff Bases Ligands, Microwaves, Transition Metals, Antibacterial

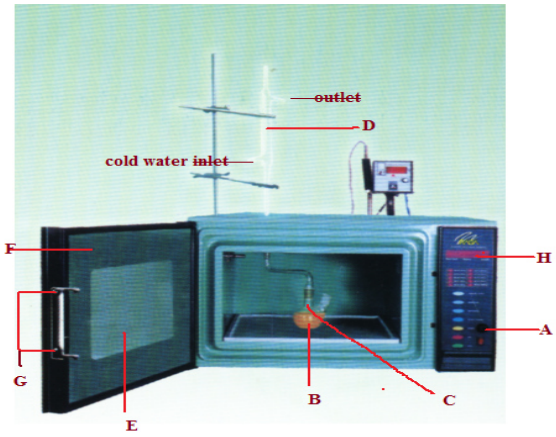
INTRODUCTION

Schiff bases play an important role as ligands in metal coordination chemistry even after almost a century since their discovery. Modern chemists still prepare Schiff base ligands are considered as "privileged ligands" They were also reported to possess, cytotoxicity[1], anticonvulsant[2], anticancer[3], and catalysis[4,]. They also have been used as antibacterials[5,].The major part of metallomesogens extensively studied includes those derived from salicylaldimine Schiff bases[6-8]. Several which are reported to be therapeutically active possess diuretic[9]and antiplasmodic[10]

The microwave-assisted synthesis offers considerable advantages over conventional heating and substantial rate enhancements of a wide range of organic reactions.[10] Microwave heating has been shown to dramatically reduce reaction times, increase product yields and enhance product purities by reducing unwanted side reactions compared to conventional heating methods[10,11]. Recently, in the literature many studies have been reported for microwave assisted synthesis of disulfides,[12] 1,2,4-triazol-5-one derivatives,[13] benzothiadiazines[14,15].

METHODS

All reagents, solvents and catalysts were of analytical grade and used directly. Melting points were determined in open capillaries and are uncorrected. The IR spectra were recorded on SHIMADZU- FT-IR 8400-Spectrophotometer. The ^{1}H –NMR spectra were recorded on Avance bruker 400 MHz NMR spectrometer. Elemental analysis was performed on Carlo Erba 1108 analyser.The microwave assisted reactions were carried out in a "QPro-M Modified Microwave Synthesis System" manufactured by Questron technologies Corporation, Ontario L4Z 2E9, Canada, as shown in Figure 1.



A. Power and Time Control Panel
B. Round Bottom Flask
C. Magnetic Stirrer
D. Refluxing Condenser Unit
E. Observation Window
F. Door Assembly
G. Safety Interlock System
H. Display Unit

Figure 1

SYNTHESIS

Synthesis of 3-Bromo-4-Methoxy Benzoic Acid: (Conventional)

Potassium bromated (0.01mole) dissolved in water (5 ml) was added to p-methoxy benzoic acid (0.01mole) To this solution, concentrated sulphuric acid (15 ml) was slowly added and the mixture was refluxed in water-bath for 2-3 hours. The product was isolated and crystallized from water. Yield: 80% and M.P. 120^{o}C.

Synthesis of 3-Bromo-4-Methoxy Benzoyl Chloride: (Conventional)

3-Bromo-4-methoxybenzoic acid (0.01mole) was dissolved in $SOCl_2$ (0.02mole) was refluxed for 3-4 hours on water-bath. The excess of $SOCl_2$ was distilled off and thus solid product was obtained.

Synthesis of 3-Bromo-4-Methoxy Benzohydrazide: (Microwave-300watts)

A mixture of 3-Bromo-4-methoxy benzoyl chloride (0.01mole) in methanol (20 ml) and hydrazine hydrate (0.01mole) was refluxed for 5-6min/ hr in microwave or 8-10hrs in conventional reaction. The reaction mixture was poured into ice cold water. The product was isolated and crystallized from ethanol. Yield 82%, M.P. 175-180^{o}C

Synthesis of Potassium [(3-Bromo-4-Methoxyphenylcarbonyl] Hydrazine Carbodithioate: (Conventional)

A mixture of potassium hydroxide (0.015mole) in absolute ethanol (25 ml), 3-Bromo-4-methoxy benzoic acid hydrazide (0.01mole) and carbon disulphide (1.14 ml, 0.015mole) were stirred for 10-12 hrs. The product was precipitated by adding diethyl ether (50 ml). Yield 75%, M.P.153^{0} C.

Synthesis of 4-Amino-5-(3-Bromo-4-Methoxy Phenyl)-4H-1, 2, 4-Triazole-3thiol: (Microwave-400 Watts and Conventional)

A suspension of Potassium [(3-Bromo-4-methoxyphenyl)-carbonyl]hydrazinedithiocarbamate (0.01mole), hydrazine hydrate (0.02mole) in methanol was refluxed with stirring for 8 hrs in conventional method and 8-10 mins in microwave method. The content was diluted in cold water and acidified with glacial acetic acid get the product. It was crystallized from ethanol. Yield 78% M. P. 198^{o}C.

Synthesis of 5-(3-Bromo-4-Methoxyphenyl)-4-{[Substituted-Phenylmethylidene] Amino}-4H-1,2,4-Triazole-3-thiol: (Microwave-400 Watts and Conventional)

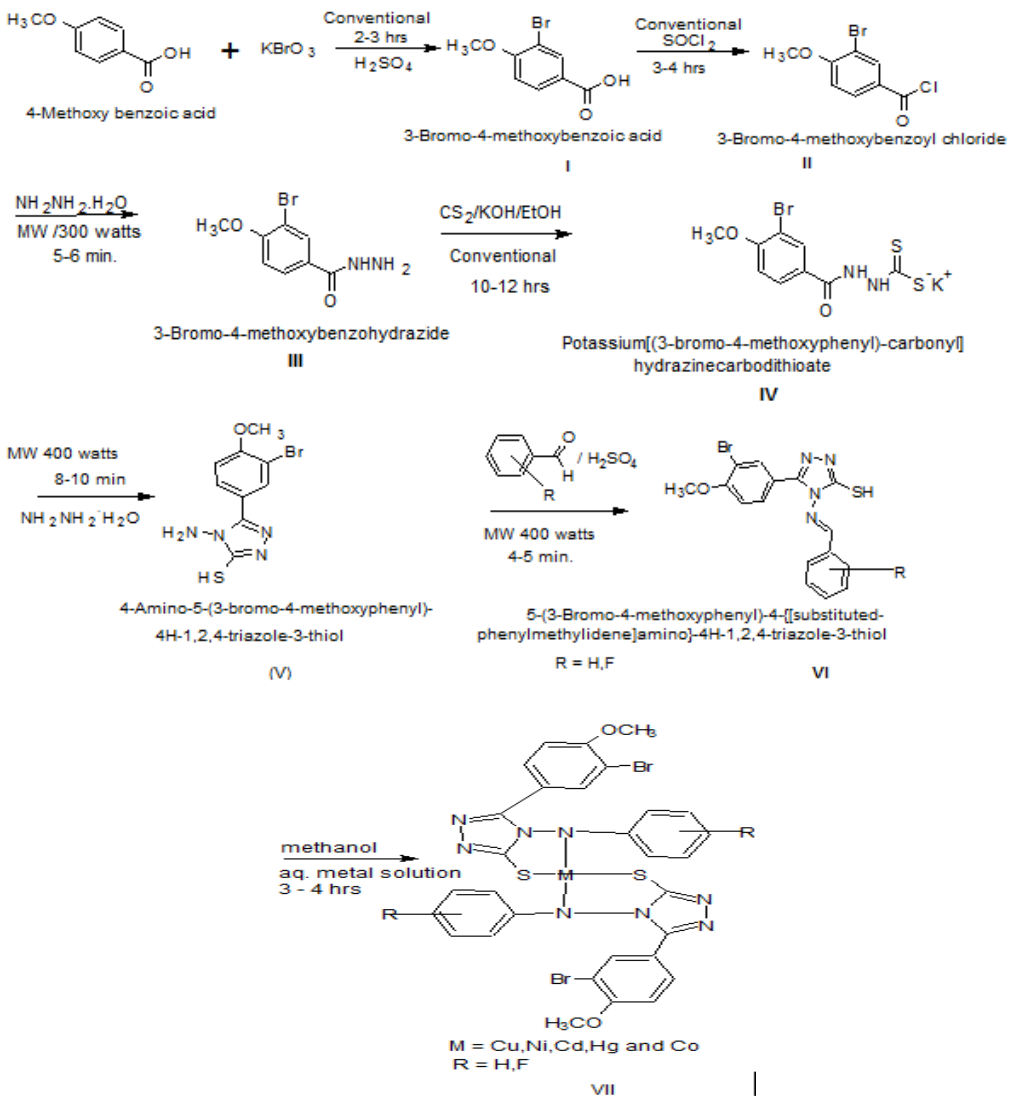
4-Amino-5-(3-bromo-4-methoxy phenyl)-4H-1,2,4 triazole-3-thiol (0.01mole) in methanol and (0.01mole) various aldehydes (like benzaldehyde and p-flouro benzaldehyde) was refluxed for 8-10 hours for conventional method and 4-5 mins for microwave method with constant stirring in presence of concentrated sulphuric acid. The precipitates were filtered, dried and crystallized with ethanol. Compounds SB_1 and SB_2 were obtained.

Synthesis of Metal Complexes: (Microwave-500 Watts and Conventional)

Metal salts (0.01mole) and SB_1/SB_2 (0.02mole) in methanol were refluxed for 3-4 hours. The precipitates obtained were filtered, dried and crystallized with methanol.

RESULTS AND DISCUSSIONS

The series of different Schiff base ligands (SB_1 and SB_2) and its corresponding metal complexes were synthesized as shown in **Scheme 1**



Scheme 1

In our investigation, Schiff base ligands and its metal complexes were synthesized by microwave method as well as conventional method in ethanol at 300-400 watts as per experimental section. The comparison data of reaction time and yield of conventional and microwave method and characteristics of the novel synthesized compounds is summarized Table 1

Table 1: Characteristics of New Compounds Synthesized

Compound	Molecular Formula	Molecular Weight	% Yield Time/min 400 watts Microwave Method	% Yield Time/hr Conven. Method	%Analysis Found (Calc.)		
					C %	H %	N %
Cu-SB_1	$C_{30}H_{22}Br_2CuN_8O_2S_2$	814.03	72 (7.0)	62 (8.0)	44.26 (44.25)	2.72 (2.70)	13.77 (13.78)
Cd-SB_1	$C_{30}H_{22}Br_2CdN_8O_2S_2$	862.89	74 (8.0)	65 (9.0)	41.71 (41.73)	2.57 (2.55)	12.99 (12.98)
Hg-SB_1	$C_{30}H_{22}Br_2HgN_8O_2S_2$	951.07	69 (7.0)	60 (10.0)	37.89 (37.87)	2.33 (2.31)	3.36 (3.35)
Ni-SB_1	$C_{30}H_{22}Br_2NiN_8O_2S_2$	809.17	73 (6.0)	65 (9.0)	44.53 (44.54)	2.74 (2.75)	13.85 (13.84)
Co-SB_1	$C_{30}H_{22}Br_2CoN_8O_2S_2$	809.47	76 (6.0)	69 (8.0)	44.52 (44.53)	2.74 (2.73)	13.84 (13.83)
Cu-SB_2	$C_{30}H_{20}Br_2CuF_2N_8O_2S_2$	850.01	70 (8.0)	63 (8.0)	42.39 (42.38)	2.37 (2.36)	13.18 (13.17)
Cd-SB_2	$C_{30}H_{20}Br_2CdF_2N_8O_2S_2$	898.87	72 (6.0)	60 (9.0)	40.09 (40.07)	2.24 (2.23)	12.47 (12.46)
Hg-SB_2	$C_{30}H_{20}Br_2HgF_2N_8O_2S_2$	987.05	74 (5.0)	65 (10.0)	36.50 (36.54)	2.04 (2.03)	11.35 (11.34)
Ni-SB_2	$C_{30}H_{20}Br_2NiF_2N_8O_2S_2$	845.16	75	69	42.63 (42.62)	2.39 (2.38)	13.26 (13.25)

Elucidation of the structures of the synthesized compounds was in accordance with the proposed structures. The strong IR band at 1585 cm^{-1}, for υ(C=N) azomethine of the ligand is shifted to lower frequency 1601 cm^{-1}, suggesting co-ordination of azomethine nitrogen to the metal ion and ir band at 1025 cm-1 for υ(C-S) triazole ring of ligand is shifted to lower frequency 1050 cm^{-1}, suggesting co-ordination of thiol sulfur of triazole ring to the metal ion. The band observed at ~ 3481cm^{-1} due to υ(OH) in free ligand is unchanged in Co-SB_1 complex suggesting, that this -OH does not take part in complex formation. The new bands appeared in the region ~508 cm^{-1} and ~480 cm^{-1} are probably due to the formation of M-S and M-N respectively. It proves that the spectra are in agreement with the synthesized compound.

The characteristic IR vibration and ^1H NMR chemical shifts are given in in Tables 2 and 3 respectively as well as data given below.

Table 2: Assignment of IR Bands (cm^{-1}) of Metal Complexes

Compound	Alkane		Aromatic		Triazole				(Ar-O-R)	
	C-H asym.	C-H sym.	C-H str.	C=C	C=N	C-N	N-N	C-S	C-O-C	-C=N
Cu-SB_1	2950	2858	1271	1496	1602	1210	1018	1025	1030	1585
Cd-SB_1	2948	2859	3045	1498	1535	1172	1033	1064	1266	1603
Hg-SB_1	2944	2852	3052	1495	1555	1167	1101	1055	1245	1621
Ni-SB_1	2945	2856	3047	1488	1542	1184	1012	1045	1265	1632
Co-SB_1	2942	2855	3055	1497	1543	1186	1021	1055	1273	1613
Cu-SB_2	2943	2858	3050	1484	1636	1188	1018	1051	1273	1602
Cd-SB_2	2949	2850	3047	1492	1633	1189	1021	1059	1266	1605
Hg-SB_2	2951	2853	3052	1482	1635	1172	1033	1045	1254	1601
Ni-SB_2	2944	2854	3043	1478	1630	1180	1019	1053	1272	1607

Table 3: Assignment of ^{1}H NMR Bands (cm^{-1}) of Metal Complexes

Compound	Assignments (δ ppm) s : Singlet d: Doublet dd: Doublets of Doublets Solvent : DMSO-d_6
Cu-SB_1	$CDCl_3$:3.95(s,6H,Ar-O-CH3); 7.04(d,2H,Ar-H);7.06 (d, 2H,Ar-H);8.22(s, 2H,Ar-H);7.92(m, 10H,Ar-H)
Cd-SB_1	$CDCl_3$:3.96(s,6H,Ar-O-CH3); 7.06(d,2H,Ar-H);7.09 (d, 2H,Ar-H);8.36(s, 2H,Ar-H);7.82(m, 10H,Ar-H)
Hg-SB_1	$CDCl_3$:3.93(s,6H,Ar-O-CH3); 7.05(d,2H,Ar-H);7.07 (d, 2H,Ar-H);8.26(s, 2H,Ar-H);7.93(m, 10H,Ar-H)
Ni-SB_1	$CDCl_3$:3.92(s,6H,Ar-O-CH3); 7.04(d,2H,Ar-H);7.06 (d, 2H,Ar-H);8.24(s, 2H,Ar-H);7.82(m, 10H,Ar-H)
Co-SB_1	$CDCl_3$:3.95(s,6H,Ar-O-CH3); 7.04(d,2H,Ar-H);7.06 (d, 2H,Ar-H);8.24(s, 2H,Ar-H);7.92(m, 10H,Ar-H)
Cu-SB_2	$CDCl_3$:3.95(s,6H,Ar-O-CH3);); 7.06 (d,2H,Ar-H);7.06 (d, 2H,Ar-H);8.23(s, 2H,Ar-H);7.92-8.05 (m, 10H,Ar-H)
Cd-SB_2	$CDCl_3$:3.91(s,6H,Ar-O-CH3);); 7.07(d,2H,Ar-H);7.09 (d, 2H,Ar-H);8.22(s, 2H,Ar-H);7.91-8.05(m, 10H,Ar-H)
Hg-SB_2	$CDCl_3$:3.95(s,6H,Ar-O-CH3);); 7.06(d,2H,Ar-H);7.09 (d, 2H,Ar-H);8.23(s, 2H,Ar-H);7.91-8.05(m, 10H,Ar-H)
Ni-SB_2	$CDCl_3$:3.94(s,6H,Ar-O-CH3);); 7.04(d,2H,Ar-H);7.07 (d, 2H,Ar-H);8.21(s, 2H,Ar-H);7.92-8.04 (m, 10H,Ar-H)

The anti-bacterial activities were studied against three strains *Staphylococcus aureus, Escherichia coli, and Psuedonomas aeruginosa,* using Streptomycin as a standard drug and results are presented in Table 4.

Table 4: Antibacterial Activity of Synthesized Compounds

Compound No.	STRAIN P.aeruginosa	E.Coli	S.aureus
	(Conc. in µg/mL, Zone of Inhibition in mm) MIC in µg		
Cu-SB_1	1200	400	50
Cd-SB_1	400	200	10
Hg-SB_1	100	200	10
Ni-SB_1	150	200	30
Co-SB_1	1000	50	50
Cu-SB_2	200	600	10
Cd-SB_2	300	200	20
Hg-SB_2	200	50	50
Ni-SB_2	100	200	10

Ligand SB_1

^{1}H NMR($CDCl_3$, 400 MHz) δ 3.95(s, 3H,Ar-O-CH_3); 3.97(s, 1H, Ar-SH), 7.01(d, 1H,Ar-H); 7.03(d, 1H,Ar-H);8.23(s, 1H,Ar-H);10.38(s, 1H,ArNH);7.93(dd, 2H,Ar-H),7.96(dd, 2H,Ar-H) .8.06 (s, 1H,Ar- H); IR (KBr,cm^{-1})alkane 2950 (C-H) asym, 2858(C-H sym),aromatic 1271(C-H),1496 (C=C), triazole 1602 (C=N), 1210(C-N), 1018 (N-N),1025(C-S), Ar-O-Ar 1030(C-O-C),1585(-C=N-). **Anal. Calcd. for $C_{16}H_{13}BrN_4OS$ C 49.37, H 3.37,N 14.39,O 4.11,S 8.24; found: C 49.36, H 3.35, N 14.39, O 4.10, S 8.22**

Ligand SB_2

^{1}H NMR($CDCl_3$, 400 MHz) δ 3.96(s, 3H,Ar-O-CH_3); 3.97(s, 1H, Ar-SH), 6.99(d, 1H,Ar-H) ;7.029 (d, ^{1}H,Ar-H);8.24(s, 1H,Ar-H);10.72(s, 1H,Ar-NH);7.94(dd, 2H,Ar-H), 7.98(dd, 2H,Ar-H); IR (KBr,cm^{-1}) alkane 2950 (C-H); asym, 2858(C-H sym),aromatic 1298(C-H),1496 (C=C), triazole 1600(C=N); 1232(C-N),1016(N-N),1020(C-S), Ar-O-Ar 1050(C-O-C),1610(-C=N-),**Anal Calcd. for $C_{16}H_{12}FBrN_4OS$ C 47.19, H 2.97,N 13.76,Br 19.62,F 4.66,N 13.76,O 3.93,S 87; found: C 47.20.26, H 2.96,N 13.75,Br 19.60, F 4.67,N 13.75,O 3.92,S 7. 87**

Cu-SB_1

Yield: Microwave 72% time :7 mins/hr, Conventional 62% time:8 hrs,; ^{1}H NMR($CDCl_3$, 400 MHz) δ 3.95(s, 6H,Ar-O-CH_3); 7.04(d, 2H,Ar-H);7.06 (d, 2H,Ar-H);8.22(s, 2H,Ar-H);7.92(m, 10H,Ar- H); IR (KBr,cm^{-1})alkane 2942 (C-H) asym, 2855(C-H sym),aromatic 3055(C-H),1497(C=C), triazole 1562 (C=N),1232(C-N), 1018(N-N),1050(C-S),Ar-O-Ar 1267(C-O-C),1601(-C=N-), 688 C-Br, 589 (M-N), 560 (M-S) **Anal. Calcd. for $C_{30}H_{22}Br_2CuN_8O_2S_2$ C 44.25, H 2.70,N 13.78; found: C 44.26, H 2.72, N 13.77**

Cd-SB_1

Yield: Microwave 74% time :8 mins/hr, Conventional 65% time:9 hrs ;^{1}H NMR($CDCl_3$, 400 MHz) δ 3.96(s, 6H,Ar-O-CH_3); 7.06(d, 2H,Ar-H);7.09 (d, 2H,Ar-H);8.36(s, 2H,Ar-H);7.82(m, 10H,Ar-H); IR (KBr,cm^{-1})alkane 2948(C-H) asym, 2859(C-H sym),aromatic 3045(C-H), (C=C), triazole 1562(C=N), 1230(C-N),1019(N-N),1052(C-S),Ar-O-Ar 1265(C-O-C),1604(-C=N-), 658 C-Br,592 (M-N), 570 (M-S) **Anal. Calcd. for $C_{30}H_{22}Br_2CdN_8O_2S_2$ C 41.73, H 2.55,N 12.98; found: C 41.71, H 2.57, N 12.99**

Hg-SB_1

Yield: Microwave 69% time :7 mins/hr, Conventional 60% time:10 hrs ;^{1}H NMR($CDCl_3$, 400 MHz) δ 3.93(s, 6H,Ar-O-CH3); 7.05(d, 2H,Ar-H);7.07(d, 2H,Ar-H);8.26(s, 2H,Ar-H);7.93(m, 10H,Ar- H); IR (KBr,cm^{-1})alkane 2952(C-H) asym, 2858(C-H sym), aromatic 3043(C-H), 1496(C=C), triazole 1558(C=N) 1210(C-N), 1018(N-N), 1058(C-S), Ar-O-Ar 1260(C-O-C),1608(-C=N-), 668 C-Br, 544 (M-N), 580 (M-S)**; Anal. Calcd. for $C_{30}H_{22}Br_2HgN_8O_2S_2$ C 37.87, H 3.31,N 13.70; found: C 37.89, H 2.33, N 13.77**

Ni-SB_1

Yield: Microwave 73% time: 6 mins/hr, Conventional 65% time:10 hrs;^{1}H NMR($CDCl_3$, 400 MHz) δ 3.92(s, 6H,Ar-O-CH_3); 7.04(d, 2H,Ar-H);7.06(d, 2H,Ar-H);8.24(s, 2H,Ar-H);7.82(m, 10H,Ar-H); IR (KBr,cm^{-1})alkane 2945(C-H) asym, 2856(C-H sym),aromatic 3047(C-H),1488(C=C), triazole 1542(C=N)**,** 1184(C-N), 1012(N-N),1045(C-S),Ar-O-Ar 1265(C-O-C),1632(-C=N-), 638 C-Br, 504 (M-N), 580 (M-S) **Anal. Calcd. for $C_{30}H_{22}Br_2HgN_8O_2S_2$ C 37.87, H 3.31,N 13.78; found: C 37.89, H 2.33, N 13.77**

Co-SB_1

Yield: Microwave 76% time :6 mins/hr, Conventional 69% time:8 hrs; ^{1}H NMR($CDCl_3$, 400 MHz) δ 3.95(s, 6H,Ar-O-CH_3); 7.04(d, 2H,Ar-H);7.06(d, 2H,Ar-H);8.22(s, 2H, Ar-H);7.92(m, 10H,Ar-H); IR (KBr,cm^{-1})alkane 2942(C-H) asym, 2855(C-H sym);aromatic 3055(C- H),1497(C=C), triazole 1543(C=N), 1186(C-N),

1021(N-N),1055(C-S),Ar-O-Ar 1273(C-O- C), 1613(-C=N-), 640 C-Br, 508 (M-N), 570 (M-S) **Anal. Calcd. for $C_{30}H_{22}Br_2CoN_8O_2S_2$ C 44.53, H 2.73,N 13.83; found: C 44.52, H 2.74, N 13.83**

Cu-SB_2

Yield: Microwave 70% time: 8 mins/hr, Conventional 63% time:8 hrs,; ^{1}H NMR($CDCl_3$, 400 MHz) δ 3.95(s, 6H,Ar-O-CH_3); 7.06(d, 2H,Ar-H);7.06(d, 2H,Ar-H);8.23(s, 2H,Ar-H);7.92-8.05(m, 10H, Ar-H); IR (KBr,cm^{-1})alkane 2943(C-H) asym, 2858(C-H sym), aromatic 3050 C-H),1484 (C=C), triazole 1536(C=N), 1188(C-N), 1018 (N-N),1051(C-S),Ar-O-Ar 1275(C-O-C),1602(-C=N-), 608 C-Br, 504 (M-N), 488 (M-S) **Anal. Calcd. for $C_{30}H_{20}Br_2CuN_8O_2S_2$ C 42.39, H 2.37,N 13.18; found: C 42.38, H 2.36, N 13.17**

Cd-SB_2

Yield: Microwave 72% time :6 mins/hr, Conventional 60% time:9 hrs ; ^{1}H NMR($CDCl_3$, 400 MHz) δ 3.91(s, 6H,Ar-O-CH_3); 7.07(d, 2H,Ar-H);7.09(d, 2H,Ar-H);8.22(s, 2H,Ar-H);7.91-8.05(m, 10H, Ar-H); IR (KBr,cm^{-1})alkane 2943 (C-H) asym, 2858(C-H sym),aromatic 3050(C-H),1484(C=C) triazole 1636(C=N) 1188(C-N), 1018(N-N),1051(C-S),Ar-O-Ar 1273(C-O-C),1602(-C=N-),601 C-Br, 510 (M-N), 480 (M-S) **Anal. Calcd. for $C_{30}H_{20}Br_2CdN_8O_2S_2$ C 40.09, H 2.24,N 12.44; found:C 40.09, H 2.23, N 12.46**

Hg-SB_2

Yield: Microwave 74% time :5 mins/hr, Conventional 65% time:10 hrs ; ^{1}H NMR($CDCl_3$, 400 MHz) δ 3.95(s, 6H,Ar-O-CH_3); 7.06(d, 2H,Ar-H);7.09(d, 2H,Ar-H);8.23(s, 2H,Ar-H);7.91-8.05(m, 10H, Ar-H); IR (KBr,cm^{-1})alkane 2951 (C-H) asym, 2853(C-H sym), aromatic 3052(C-H),1482 (C=C), triazole 1635(C=N) 1172(C-N), 1033 (N-N),1045(C-S),Ar-O-Ar 1254(C-O-C),1601(-C=N-), 609 C-Br, 504 (M-N), 490 (M-S)**. Anal. Calcd. for $C_{30}H_{20}Br_2HgN_8O_2S_2$ C 36.50, H 2.04,N 11.35; found: C 36.54, H 2.03, N 11.34**

Ni-SB_2

Yield: Microwave 75% time: 6 mins/hr, Conventional 69% time:10 hrs ;^{1}H NMR($CDCl_3$, 400 MHz) δ 3.94(s, 6H,Ar-O-CH_3); 7.04(d, 2H,Ar-H);7.07(d, 2H,Ar-H);8.21(s, 2H,Ar-H);7.92-8.04(m, 10H,Ar-H); IR (KBr,cm^{-1})alkane 2944 (C-H) asym, 2854(C-H sym), aromatic 3043(C-H),1478 (C=C), triazole 1630(C=N), 1180 C-N), 1019 (N-N),1053 (C-S),Ar-O-Ar 1272 (C-O-C),1607(-C=N-), 612 C- Br, 510 (M-N), 492 (M-S); **Anal. Calcd. for $C_{30}H_{20}Br_2NiN_8O_2S_2$ C 42.63, H 2.39,N 13.26; found: C 42.62, H 2.38, N 13.25**

Antibacterial Activity

The anti-bacterial activity was measured by **disc diffusion method.** The surface of four Mueller-Hinton plates are inoculated with *S. aureus, E. coli, and P. aeruginosa, respectively*. A separate sterile cotton swab was used for each bacterium. The swab was immersed in the culture tube, and the excess culture was squeezed on the inner side of the test tube. The swab was then taken and streaked on the surface of the Mueller-Hinton plate three times, rotating the plate 60° after each streaking. Finally, swab was run around the edge of the agar. This procedure ensures that the whole surface has been seeded. The culture was allowed to dry on the plate for 5 to 10 minutes at room temperature. The discs of various concentrations of compounds were dispensed onto the plate either with the multiple dispensers or individually with the single unit dispenser. Contact was made between the disc and the culture by gently pressing the disc with alcohol-flamed forceps. Precautions should be taken not to press the disc into the agar or disturb the disc once placed on the agar.

The plates were incubated for 16 to 18 hours at 35°C in the incubator. The diameter of inhibition zone to the nearest millimeter was measured in millimeter (mm) by using scale against the bottom of the plate. The results are given in Table 4

CONCLUSIONS

In conclusion, a simple efficient and environmentally benign method has been developed for synthesis of various Schiff base metal complexes under microwave irradiation. This microwave irradiation method is superior from the view of a yield and reaction time compared to conventional method.

ACKNOWLEDGEMENTS

Authors are thankful to Veer Narmad South Gujarat University, Surat for providing research facilities. One of the author is also thankful to SAIF, Punjab University, Chandigarh for providing the spectral studies and Central Diagnostic laboratory, Surat, for antibacterial activity.

REFERENCES

1. Tarafder, M. T, Kasbollah A, Saravan N, Crouse, K. A, Ali, A. M, Tin, O. K, Biochem, *J. Mol. Biol. Biophys*, 2002, 6, 85.
2. Kucukguzel. I; Kucukguzel, S. G; Rollas, S; Sanis, G. O; Ozdemir. O; Bayrak. I; Altug, I; *J. Stables II, Farmaco,* 2004, 598, 39.
3. Vicini, P; Geronikaki,A; Incerti, M; Busonera,B; Poni, G; Kabras, C. A; Collas, P. L; *Bioorg. Med. Chem*, 2003, 11, 478.
4. Srinivasan, K; Michaud, P; J. K. Kochi, J. K; *J. Am. Chem, 1994,* 29, 781.
5. Kalaymann, D. L; Bartosevich, J. F; Griffin, T. S; Mason, C. J; Scovil, J. P; *J. Med. Chem*, 1979, 22, 855; *Polyh*, 2009, 28, 107.
6. Hoshino, N; *Coord. Chem.Rev*, 1998, 174, 77.
7. Paschke, R. Balkow, D; Sinn, E; *Inorg. Chem*, 2002, 41, 1949. ***seven***
8. Abe,Y; Nakazima, N; Tanase, T; Katano, S; Mukai, H; Ohta, K; *Mol. Cryt. Liq. Cryst*, 2007, 466, 129.
9. Rosenburg, B; Van Camp, L; Teroski, J. E; and Mansour, V. H; *Nature*, 1969, 222, 385.
10. Schuster, G; Heinisch, L; Scnulze, W; Ulbricht, H; and Willitzer, H; *Phytopathol*, 1984 97, 2.
11. Loupy, *A. Microwaves in Organic Synthesis,* Wiley-VCH: Weinheim, 2002; pp.1. Lidstrom, P; Tierney, J; Wathey, B; Westman, J. *Tetradron.* 2001, 57, 9225- 9283. Varma, *R.S. Green Chem.* 1999, 1, 43-55.
12. Kappe, C. O. *Angew. Chem. Int. Ed. Engl.* 2004, 43, 6250-6284.
13. Restrepo, J; Salazar, J; L'opez, S. E. *Phosphorus, Sulfur Silicon Relat.Elem.* 2011, 186, 2311-2320.
14. Shokrolahi, A; Zali, A; Mahdavi M. *Phosphorus, Sulfur Silicon Relat.Elem.* 2012,187, 535-543.
15. Karakullukcu N. T; Yasan. H; Ozturk.S. and Kutuk. H; *Phosphorus, Sulfur Silicon Relat. Elem,* DOI: 10.1080/10426507.2013.769984.