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Synthesis And Anti-Microbial Activity Of 1,2,4-Triazole Derivatives

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Abstract

The research work was aimed to design and synthesize new Schiff's bases and Amine derivatives of triazole and to evaluate them for their possible biological activities mainly anti-bacterial and anti-fungal activity. In the present work total 21 compounds were synthesized from three parent compounds parent-1, parent-2, parent-3. These parent compounds were used as nucleus for the synthesis of various Schiff base derivatives like 1 (a-g), 2(a-g), 3(a-g). All synthesized compounds were identified based on M.P. range, IR, NMR and all compounds were evaluated for anti-bacterial and anti-fungal activity.

Keywords: Anti-fungal, Anti-Bacterial, Biological activities, Schiff's bases

1. Introduction

Recent years have seen a rise in the importance of heterocyclic compounds because of their pharmacological effects. Five- and six-member heterocyclic compounds containing nitrogen, sulphur, and oxygen have played a significant role in the production of many physiologically active medications, including those with analgesic, anti-inflammatory, antidepressant, anticancer, antibacterial, and anti-fungal activity.

2. Methods & Materials

Synthesis of 3-(4-Chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine (parent-1)
Synthesis of Methyl-4-chlorobenzoate

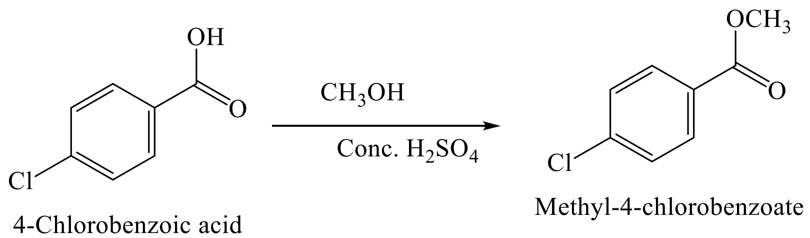


Figure: 1

Synthesis of Acid hydrazide of methyl ester of 4-Chloro benzoic acid[15, 45]

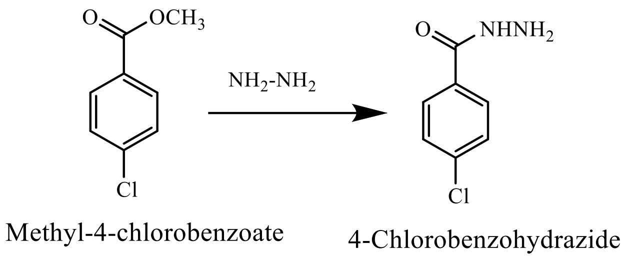


Figure: 2

Synthesis of potassium -2-(4-Chlorobenzoyl) dithiocarbazate

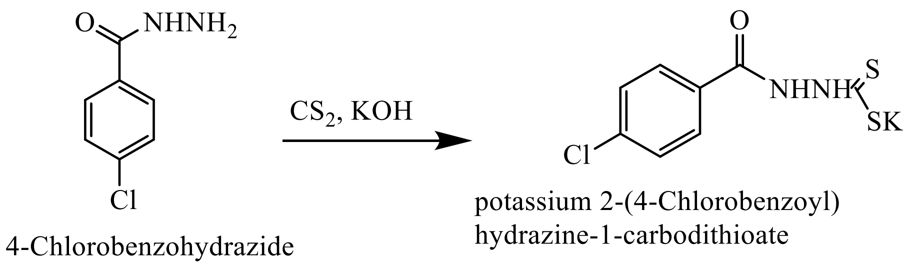


Figure: 3

Synthesis of 4-Amino- 5-(4-chlorophenyl)-4H-1,2,4-triazole-3-thiol [9,15]

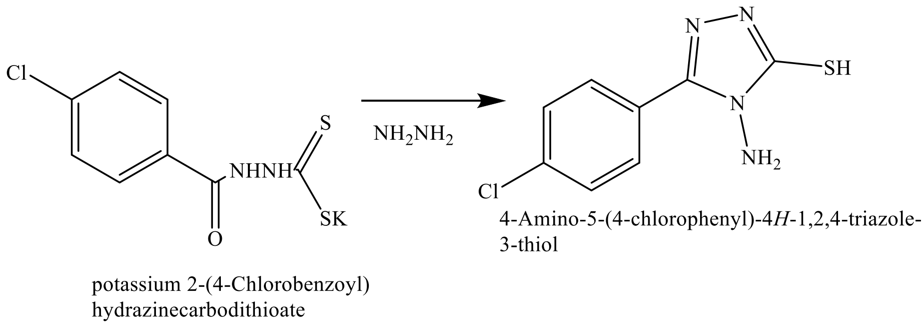


Figure: 4

Synthesis of 3-(4-Chlorophenyl)-5-methylthio-4H-1,2,4-triazole-4H-1,2,4-triazole-4-amine

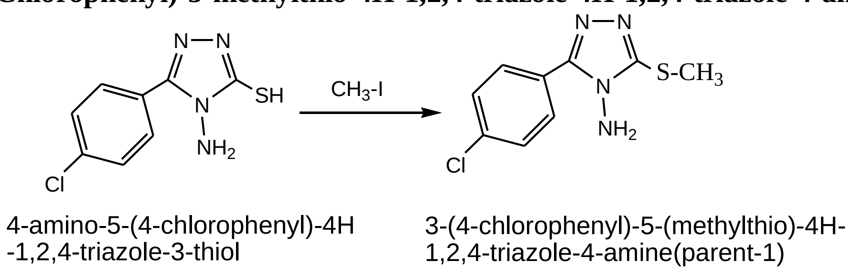


Figure: 5

Synthesis of Schiff bases derivative of (parent-1) N-Benzylidine-3-(4-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine 1(a)

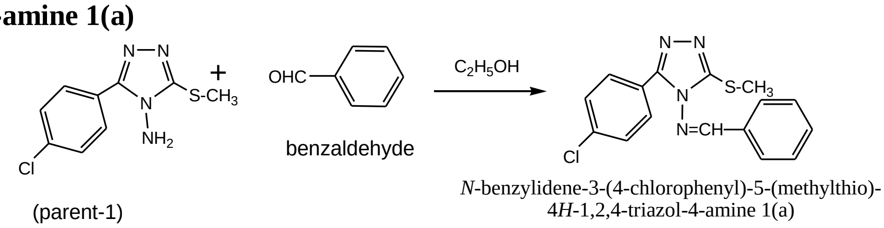
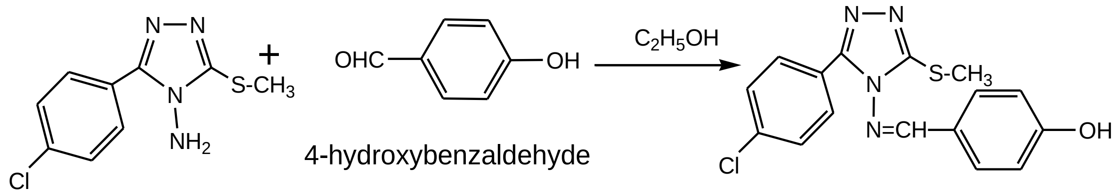


Figure: 6

Synthesis of Schiff base derivative 4-((3-(4-Chlorophenyl)-5-(methylthio)-4H 1,2,4-triazole-4-ylimino)methyl)phenol 1(b)



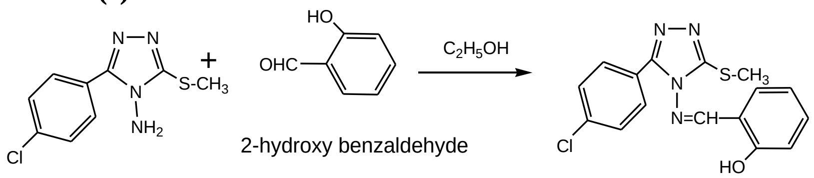
(parent-1)

4-((3-(4-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-ylimino)methyl)phenol

1(b)

Figure: 7

Synthesis of Schiff base derivative 2-((3-(4-Chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-ylimino)methyl)phenol 1(c)



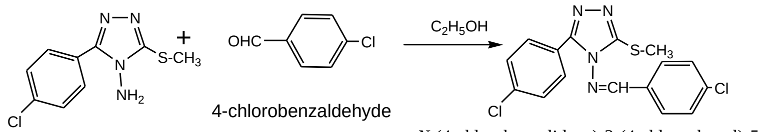
(parent-1)

2-((3-(4-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-ylimino)methyl)phenol

1(c)

Figure: 8

Synthesis of Schiff base derivative N-(4-Chlorobenzylidine-3-(4-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine 1(d)



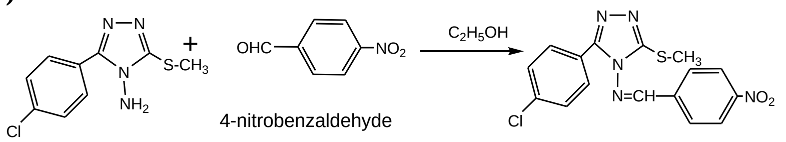
(parent-1)

N-(4-chlorobenzylidene)-3-(4-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-amine

1(d)

Figure: 9

Synthesis of Schiff base derivative N-(4-Nitrobenzylidine-3-(4-chlorophenyl)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 1(e)



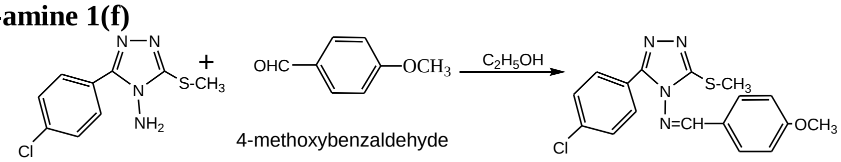
(parent-1)

N-(4-nitrobenzylidene)-3-(4-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-amine

1(e)

Figure: 10

Synthesis of Schiff bases derivative N-(4-Methoxybenzylidine-3-(4-chlorophenyl)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 1(f)



(parent-1)

N-(4-methoxybenzylidene)-3-(4-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-amine

1(f)

Figure:11

Synthesis of Schiff's base derivative 3-(4-Chlorophenyl)-N-(furan-2-ylmethylene)-5-(methylthio)-4H-1,2,4-triazole-4-amine 1(g)

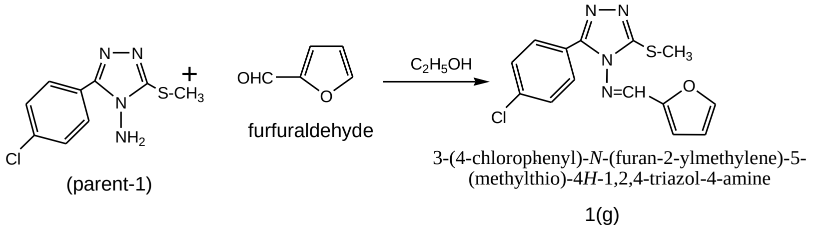


Figure: 12

Synthesis of 3-(2-Chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine (parent-2)
Synthesis of 2-chloro methyl benzoate

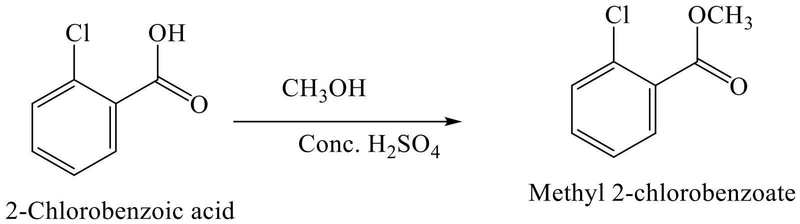


Figure: 13

Synthesis of 2-Chlorobenzohydrazide

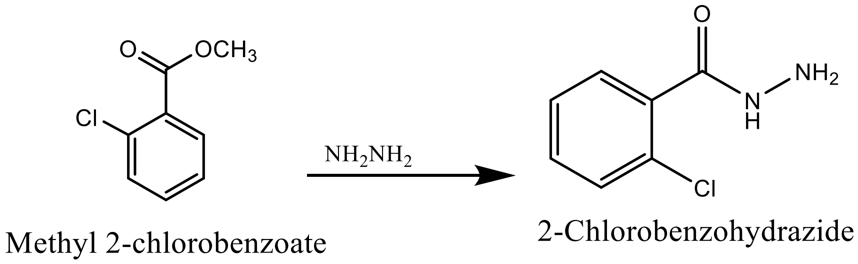


Figure: 14

Synthesis of potassium -3-(2-Chlorobenzoyl) dithiocarbazate

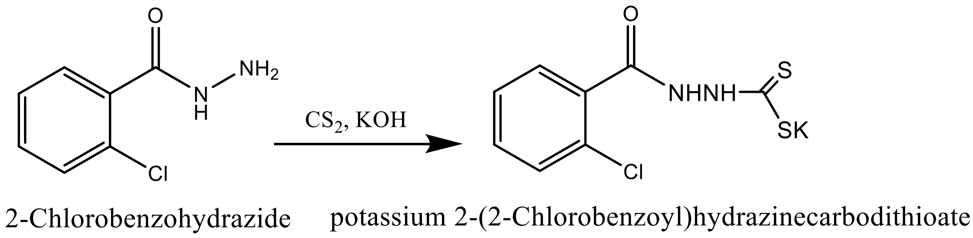


Figure: 15

Synthesis of 4-Amino- 5-(2-chlorophenyl)-4H-1,2,4-triazole-3-thiol

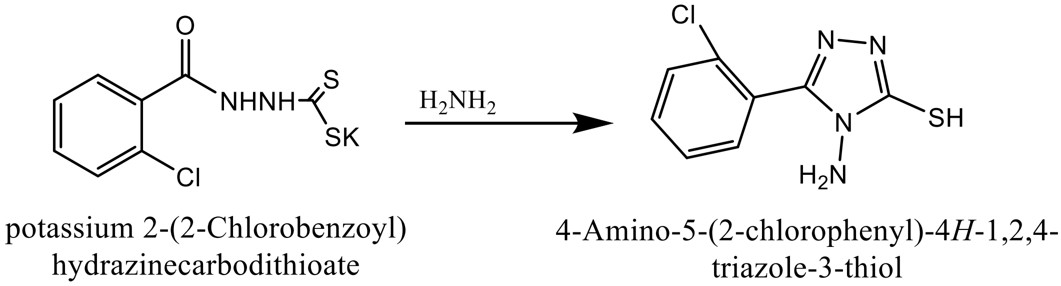
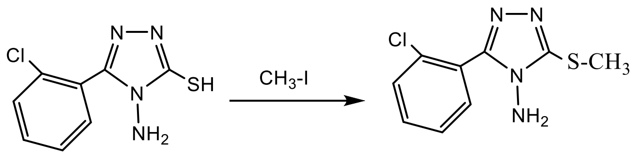


Figure: 16

Synthesis of 3-(2-Chlorophenyl)-5-methylthio-4H-1,2,4-triazole-4-amine (parent-2)



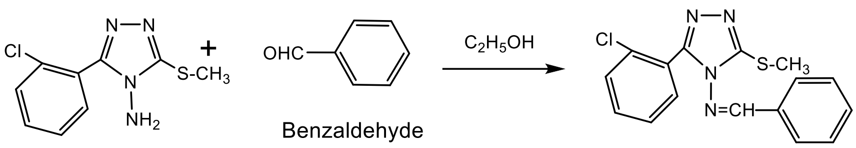
4-Amino-5-(2-chlorophenyl)-4H -1,2,4-triazole-3-thiol

3-(2-Chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine (parent-2)

Figure: 17

Synthesis of Schiff's base derivatives 2(a-g) of parent (2)

Synthesis of Schiff bases derivative N-Benzylidine-3-(2-chlorophenyl)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 2(a)



Benzaldehyde

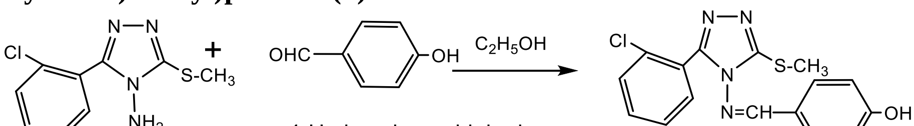
(parent-2)

N-Benzylidene-3-(2-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-amine

2(a)

Figure: 18

Synthesis of Schiff bases derivative derivative 4-((3-(2-Chlorophenyl)-5-(methylthio)-4H- 1,2,4-triazole-4-ylimino)methyl)phenol 2(b)



4-Hydroxybenzaldehyde

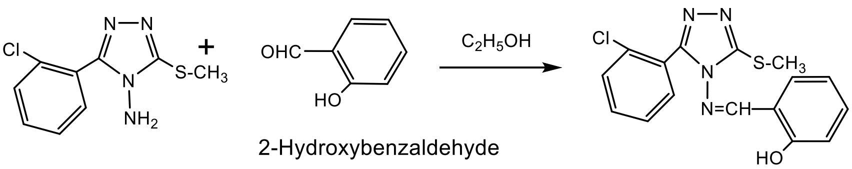
(parent-2)

4-((3-(2-Chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-ylimino)methyl)phenol

2(b)

Figure: 19

Synthesis of Schiff bases derivative 2-((3-(2-Chlorophenyl)-5-(methylthio)-4H- 1,2,4-triazole-4-ylimino)methyl)phenol 2(c)



2-Hydroxybenzaldehyde

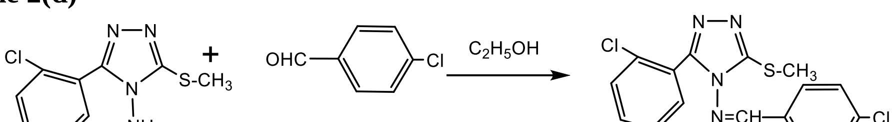
(parent-2)

2-((3-(2-Chlorophenyl)-5-(methylthio)-4H-1,2,4-triazol-4-ylimino)methyl)phenol

2(c)

Figure: 20

Synthesis of Schiff bases derivative N-(4-Chlorobenzylidine-3-(2-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine 2(d)



4-Chlorobenzaldehyde

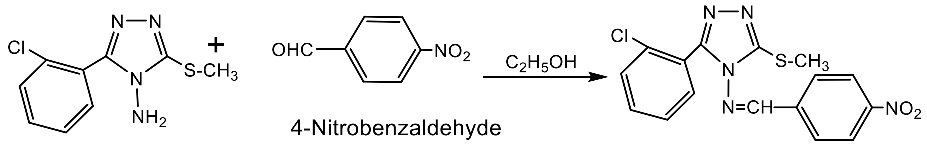
(parent-2)

N-(4-Chlorobenzylidene)-3-(2-chlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-amine

2(d)

Figure: 21

Synthesis of Schiff bases derivative N-(4-Nitrobenzylidine-3-(2-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine 2(e)

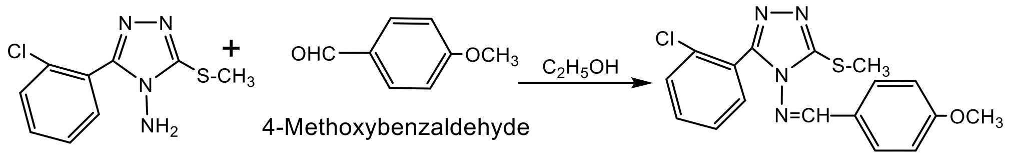


(parent-2)

N-(4-Nitrobenzylidene)-3-(2-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazol-4-amine 2(e)

Figure: 22

Synthesis of Schiff bases derivative N-(4-Methoxybenzylidine-3-(2-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine 2(f)



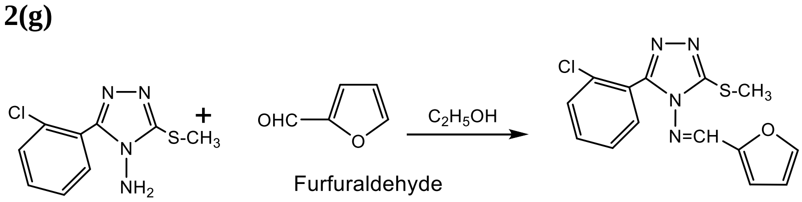
(parent-2)

N-(4-Methoxybenzylidene)-3-(2-chlorophenyl)-5-(methylthio)-4H-1,2,4-triazol-4-amine

2(f)

Figure: 23

Synthesis of Schiff bases derivative 3-(2-Chlorophenyl)-N-(furan-2-ylmethylene)-5-(methylthio)-4H-1,2,4-triazole 2(g)



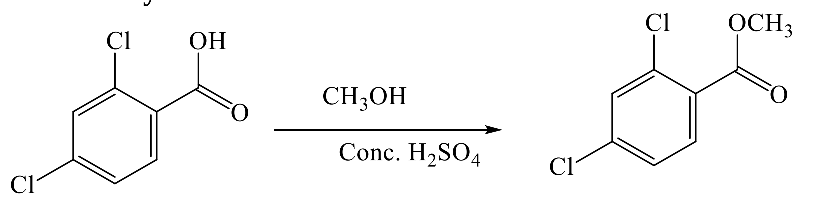
(parent-2)

3-(2-Chlorophenyl)-N-(furan-2-ylmethylene)-5-(methylthio)-4H-1,2,4-triazol-4-amine

2(g)

Figure: 24

Synthesis of 3-(2,4-Dichlorophenyl)-5-(methylthio)-4H-1,2,4- triazole-4-amine (parent-3)
Synthesis of 2,4-dichloro methyl benzoate

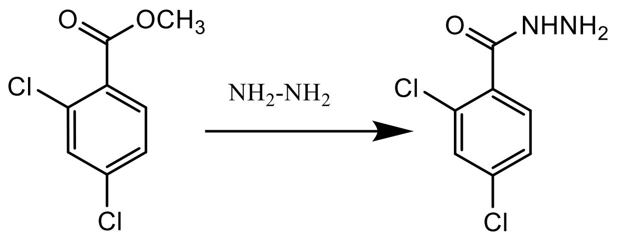


2,4-Dichlorobenzoic acid

Methyl 2,4-dichlorobenzoate

Figure: 25

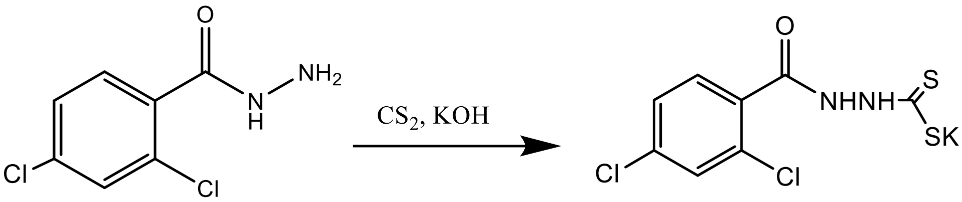
Synthesis of acid hydrazide of Methyl-2,4-dichlorobenzoate



Methyl 2,4-dichlorobenzoate 2,4-Dichlorobenzohydrazide

Figure:26

Synthesis of potassium -2-(2,4-Dichlorobenzoyl) dithiocarbazate

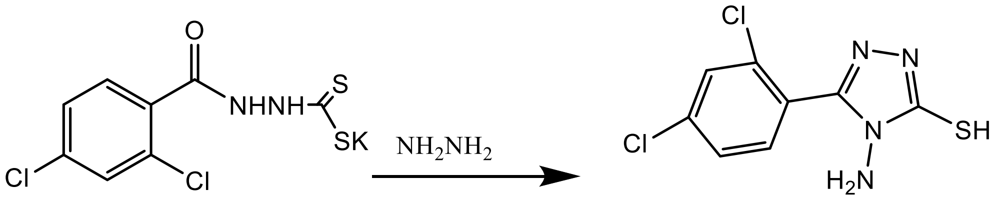


2,4-Dichlorobenzohydrazide

potassium 2-(2,4-dichlorobenzoyl) hydrazinecarbodithioate

Figure: 27

Synthesis of 4-Amino-5-(2,4-dichlorophenyl)-4H-1,2,4-triazole-3-thiol

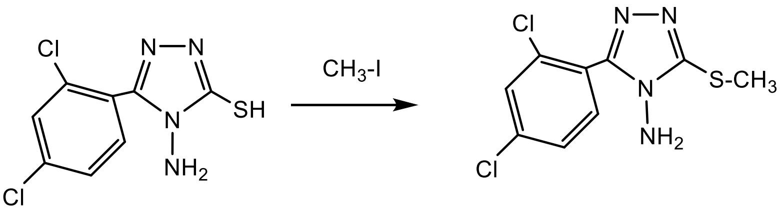


potassium 2-(2,4-dichlorobenzoyl) hydrazinecarbodithioate

4-Amino-5-(2,4-dichlorophenyl)-4*H*-1,2,4-triazole-3-thiol

Figure: 28

Synthesis of 3-(2,4-Dichlorophenyl)-5-methylthio-4H-1,2,4-triazole-4-amine (parent-3)

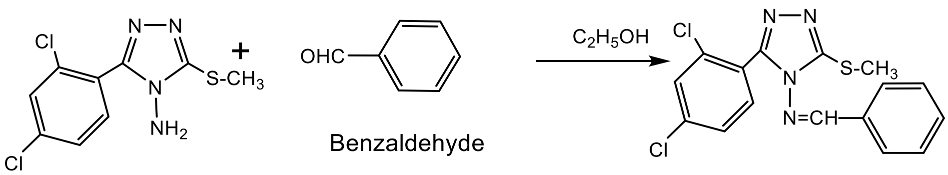


4-Amino-5-(2,4-dichlorophenyl)-4*H*-1,2,4-triazole-3-thiol

3-(2,4-Dichlorophenyl)-5-(methylthio)-4H -1,2,4-triazole-4-amine (parent-3)

Figure:29

Synthesis of Schiff bases derivatives 3 (a-g) of parent (3)
N-Benzylidine-3-(2,4-dichlorophenyl)-5-(methylthio)-4H-1,2,4-triazole-4-amine 3(a)



Benzaldehyde

(parent-3)

N-Benzylidene-3-(2,4-dichlorophenyl)-5-(methylthio)-4*H*-1,2,4-triazol-4-amine

3(a)

Figure: 30

Synthesis of Schiff bases derivative 4-((3-(2,4-Dichlorophenyl)-5-(methylthio)-4H- 1,2,4-triazole-4-ylimino)methyl)phenol 3(b)

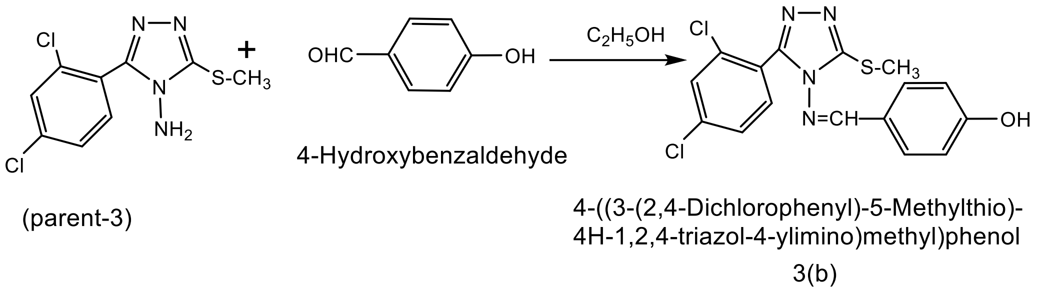


Figure: 31

Synthesis of Schiff bases derivative 2-((3-(2,4-Dichlorophenyl)-5-(methylthio)-4H- 1,2,4-triazole-4-ylimino)methyl)phenol 3(c)

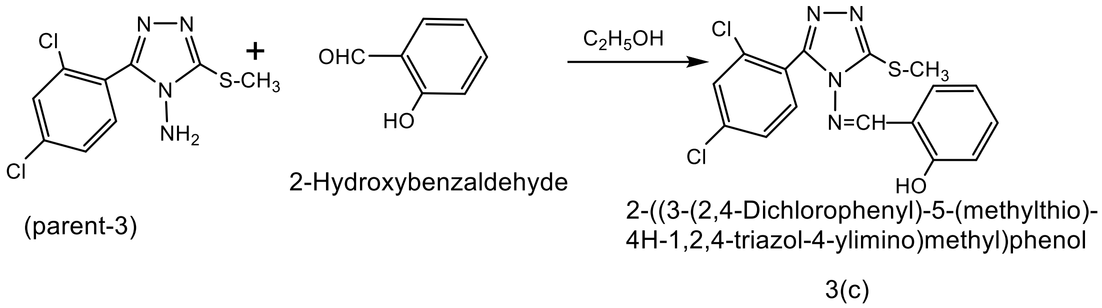


Figure:32

Synthesis of Schiff bases derivative N-(4-Chlorobenzylidine-3-(2,4-dichlorophenyl)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 3(d)

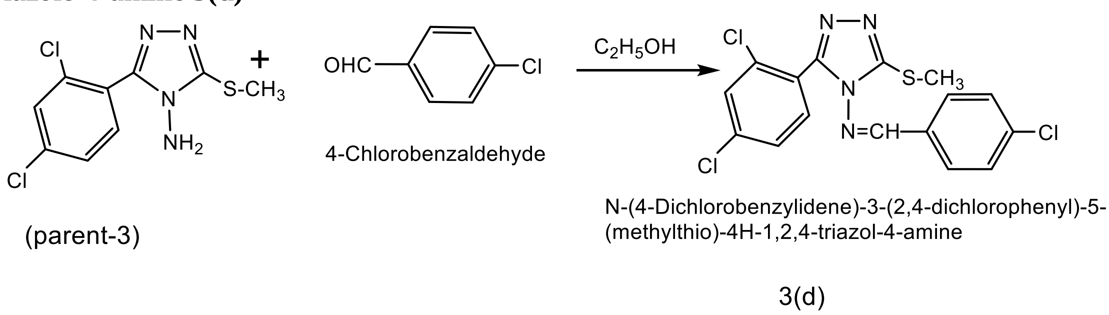


Figure: 33

Synthesis of Schiff bases N-(4-Nitrobenzylidine-3-(2,4-dichlorophenyl)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 3(e)

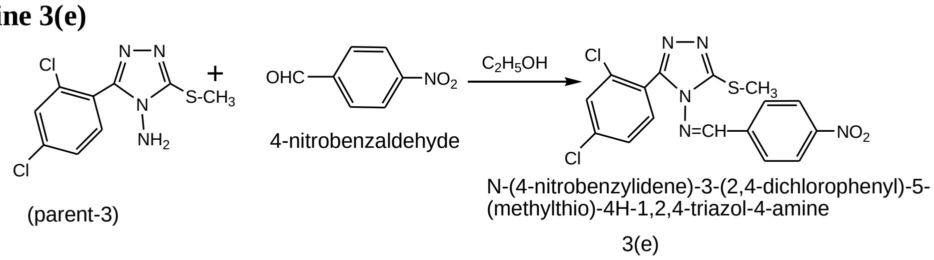
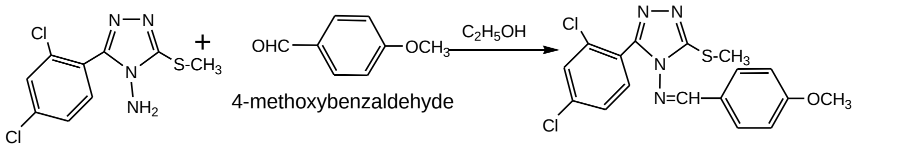


Figure: 34

Synthesis of Schiff bases derivative N-(4-Methoxybenzylidine-3-(2,4 dichlorophenyl)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 3(f)



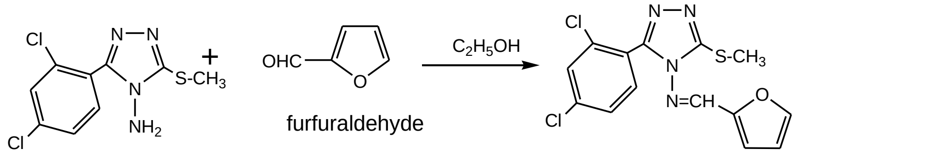
(parent-3)

N-(4-methoxybenzylidene)-3-(2,4-dichlorophenyl)-5-(methylthio)-4H-1,2,4-triazol-4-amine

3(f)

Figure: 35

Synthesis of Schiff bases derivative 3-(2,4-Dichlorophenyl)-N-(furan-2-ylmethylene)- 5-(methylthio)-4H-1,2,4-triazole-4-amine 3(g)



(parent-3)

3-(2,4-dichlorophenyl)-N-(furan-2-ylmethylene)-5-(methylthio)-4H-1,2,4-triazol-4-amine

3(g)

Figure: 36

3. In Vitro Antimicrobial Sensitivity Determination Test

Well Diffusion Method

Well diffusion method was employed to assess the antibacterial and antifungal activities.

Preparation of Stock Solution (Test Compounds)

Newly synthesized chemical stock solutions were diluted in 100% (DMSO). Different concentrations of the stock solutions were created. Stocks of 15 mg per 12 mL (A), 15 mg per 6 mL (B), and 15 mg per 3 mL (C) were made at varied quantities. 100 liters of the diluted stock solution containing the test compound concentrations of A-125 g, B-250 g, and C-500 g were taken. They were promptly injected using a sterilised micropipette into each agar well.

Stock Solution Preparation of standard drugs

For the fluconazole stock, several concentrations of 16.95 mg per 12 mL (A), 16.95 mg per 6 mL (B), and 16.95 mg per 3 mL (C) were created. 100 mL of the diluted stock solution were taken, each holding the standard drug concentrations of A-62.5 µg, B-125 , C-250 µg, and D-500 µg. Allowance for the potency of the powder (standard drugs) were made by using following formula:

$$weight\ of\ powder\ (mg) = \frac{\text{volume of solvent (ml) x concentration} \left(\frac{mg}{ml}\right)}{\text{potency of powder} \left(\frac{mg}{g}\right)}$$

Test microorganisms

The three bacterial strains and the two fungal strains used in the present study were the clinical isolates obtained from Institute of microbial technology sector 39-A, Chandigarh, India. **Bacterial Inoculum Preparation** Reactivated clinical isolate cultures on to Sabouraud dextrose agar medium and Sabouraud dextrose broth and incubated at 35 °C for 24 hours.

IR spectral analysis:

IR spectra of Compounds in KBr pellet was recorded on a Shimadzu IR spectrophotometer. Potassium bromide pellets were prepared by 200 mg of dehydrated Potassium bromide to this added 1 mg of compound and stirred well in mortar. The mixture is placed in die and given pressure of 10-15 torr. Then placed in a pellet holder and scanned by the mixture via IR.

4. Result & Discussion

Physical characterization of Synthesized compounds

Table: 1 Physical characterization data of synthesized compounds

Compound Code	Yield%	M.P. range (°C)	Rf value	Solvent system	Solubility
Parent-1	64	164-166	0.86	Ethylacetate: n-Hexane (3: 2)	DMF Chloroform
1(a)	71	132-134	0.86	Ethyl acetate: Butanol (1: 2)	DMF Chloroform
1(b)	64	126-128	0.82	Ethyl acetate: Butanol (1: 2)	DMF Chloroform
1(c)	75	144-146	0.74	Ethylacetate: n-Hexane (3: 2)	DMF Ethanol
1(d)	74	138-140	0.64	Ethylacetate: n-Hexane (1: 2)	DMF Ethanol
1(e)	91	186-188	0.74	Ethylacetate: n-Hexane (1: 2)	DMF Ethanol
1(f)	73	176-178	0.64	Chloroform: Acetic Acid (2:1)	DMF Chloroform
1(g)	90	152-154	0.64	Chloroform: Acetic Acid (2:1)	DMF Ethanol
Parent-2	64	164-166	0.86	Ethylacetate: n-Hexane (1: 2)	Chloroform Ethanol
2(a)	71	128-130	0.86	Ethylacetate: Butanol (1: 2)	DMSO Ethanol
2(b)	64	126-128	0.82	Ethylacetate: Butanol (1: 2)	DMSO Ethanol
2(c)	75	144-146	0.74	Ethylacetate: Butanol (1: 2)	DMSO Ethanol
2(d)	74	138-140	0.64	Ethylacetate: n-Hexane (1: 2)	DMSO Ethanol
2(e)	91	186-188	0.74	Ethylacetate: n-Hexane (1: 2)	DMF $CHCl_3$
2(f)	90	176-178	0.64	Ethylacetate: n-Hexane (1: 2)	DMF $CHCl_3$
2(g)	64	152-154	0.86	Ethylacetate: n-Hexane	Ethanol DMF

				(1: 2)	
Parent-3	64	164-166	0.86	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(a)	71	153-155	0.82	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(b)	75	144-146	0.74	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(c)	74	138-140	0.64	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(d)	91	122-124	0.74	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(e)	73	176-178	0.64	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(f)	90	152-154	0.64	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF
3(g)	64	164-166	0.86	Ethylacetate: n-Hexane (3: 1)	Ethanol DMF

Results of Antibacterial Activity of compounds

Table: 2. Zone of inhibition (diameter in mm) of Synthesized compounds

Zone of inhibition by agar well diffusion (diameter in mm)									
Comp. Code	***S. aureous***			***B. subtilis***			***E. coli***		
	125	***250***	***500***	***125***	***250***	***500***	***125***	***250***	***500***
	µg/100 µL			µg/100µL			µg/100µL		
1(a)	-	-	10	-	-	11	-	-	11
1(b)	-	12	14	-	10	14		10	12
1(c)	-	-	10	-	12	15	12	14	16
1(d)	-	10	12	10	13	15	-	-	12
1(e)	-	-	12	-	10	12	-	12	14
1(f)	-	-	10	12	14	16	-	-	12
1(g)	13	15	19	10	13	17	-	-	12
2(a)	-	-	12	-	-	14	12	14	18
2(b)	-	14	16	-	12	14	-	-	12
2(c)	-	10	12	-	-	-	-	-	12
2(d)	12	15	19	-	13	15	-	-	13
2(e)	-	-	13	-	-	13	14	17	19
2(f)	-	15	16	-	-	11	-	-	-
2(g)	-	14	18	-	11	15	-	-	12
3(a)	-	-	11	-	-	12	-	-	14
3(b)	-	13	15	-	12	14		10	12
3(c)	-	-	10	-	12	15	12	14	16
3(d)	-	10	12	10	13	15	-	-	12
3(e)	-	-	12	-	10	12	-	12	14
3(f)	-	-	10	-	12	14	-	-	12

3(g)	12	15	19	10	14	17	-	-	11
Control (-)	-	-	-	-	-	-	-	-	-
Ampicillin	19	25	35	15	19	24	11	14	18

(–), indicates there was no observed zone of inhibition

Table-3 Spectral and elemental characterization of Synthesized Compounds

No	**IR spectral data (cm^{-1}) (KBr)**	**[1]HNMR (DMSO-d6) δ**
Parent-1	1603,1582 C=N str.),759 (mono substituted benzene) ,3272,3172 (-NH str.),3127,3109 (=CH str.),3064,3030 (Ar-H str.) , 1247(N-N=C str.) , 696 (C-S-C str.)	7.44 (2H, t , Ar-H_a), 7.33(2H, t , Ar-H_b), 2.46 (3H,s,CH_3-S-) .
1(a)	1603,1582(C=N str.), 759 (mono substituted benzene) 3120, 3109 (=CH- str.), 3064,3030 (Ar-H str.),1247(N-N=C str.), 696 (C-S-C str.)	7.43 (2H, t, Ar-H_a), 7.30 (2H, t, Ar-H_b) , 7.6 (2H, q, Ar-H_c), 7.20 (3H, t, Ar-H_d), 2.47(3H , s, CH_3-S-), 8.1 (s, -N=CH)
1(b)	1603,1582(C=N str.), 756 (mono substituted benzene) , 3411(OH-stretch) , 3127,3109 (=CH- str.), 3054,3020 (Ar-H str.), 1250 (N-N=C str.), 690 (C-S-C str.)	7.43(2H, t, Ar-H_a), 7.20(2H, t, Ar-H_b), 2.47 (3H,s,CH_3-S-) , 6.8(2H, t, Ar-$H_{a'}$), 8.1(s, N=CH)
1(c)	1603, 1582(C=N str.), 756 (mono substituted benzene) , 3420(OH-stretch) , 3126,3100 (=CH- str.), 3054,3020 (Ar-H str.),1250 (N-N=C str.), 690 (C-S-C str.)	7.42(2H, t, Ar-H_a), 7.33 (2H, t, Ar-H_b), 2.47 (3H, s, CH_3-S-) , 6.8(2H, d, Ar-H_c), 8.1(s, N=CH)
1(d)	7.42 (2H, t, Ar-H_a), 7.33 (2H, t, Ar-H_b), 2.47 (3H, s, CH_3-S-) , 7.6(2H, d, Ar-H_c), 7.3(2H,d,Ar-H), 8.1(s, N=CH)	N-(4-chlorobenzylidine-3-(4-chlorophenyl)-5-(methyl thio)-4H-1,2,4-triazole-4-amine
1(e)	1681 (C=C stretch), 1311 (C-N stretch), 1641 (N=C stretch), 1066 (C-S stretch), 1575 (C=N-N stretch), 1534 (C-NO2 stretch) , 603 , 1582(C=N) , 759 (monosubstituted benzene) , 696 (C-S-C)	7.42(2H, t, Ar-H_a), 7.33(2H, t, Ar-H_b), 2.47 (3H, s, CH_3-S-) , 7.9(2H, t, Ar-H_c), 8.2(2H, t, Ar-H_d), 8.1(s, N=CH)
1(f)	1600,1580(C=N),750 (mono substituted benzene) ,3272,3174 (-NH),3127,3109 (=CH),3060,3030 (Ar-H),1245(N-N=C),690 (C-S-C)	7.43(2H, t, Ar-H_a), 7.20 (2H, t, Ar-H_b) , 2.43 (3H,s, CH_3-S-) , 3.73 (s, 3H, OCH3), 7.5(2H, t, Ar-H_c), 6.8(2H, t, Ar-H_d), 8.1(s, N=CH)
1(g)	1603, 1582(C=N str.), 759 (mono substituted benzene) ,3272,3172 (-NH - str.),3127,3109 (=CH- str.) , 3064, 3030 (Ar-H), 1247(N-N=C str.) , 696 (C-S-C str.)	7.44(2H, t, Ar-H_a), 7.34(2H, t, Ar-H_b), 2.4 (3H, s,CH_3-S-) , 6.3(d, 2H- furan), 8.1(s, -N=CH)
Parent-2	1603, 1582(C=N str.),759 (mono substituted benzene) ,3272,3172 (-NH- str.), 3127,3109 (=CH-), 3064, 3030 (Ar-H), 1247(N-N=C str.), 696 (C-S-C str.)	7.43-7.16 (m, Ar-H), 2.46 (3H, s, CH_3-S-) , 2.0(-NH_2)
2(a)	1603, 1582 C=N str.), 759 (mono substituted benzene) , 3127,3109 (=CH-), 3064,3030 (Ar-H), 1247(N-N=C str.), 696 (C-S-C str.)	7.43-7.16 (m, Ar-H), 7.6 (2H, q, Ar-H_c), 7.20 (3H, t, Ar-H_d), 2.47(3H , s, CH_3-S-), 8.1(s, N=CH)
2(b)	1603, 1582(C=N str.),756 (mono substituted benzene) , 3411(OH-stretch) , 3127,3109 (=CH), 3020 (Ar-H), 1250 (N-N=C str.), 690 (C-S-C str.)	7.33-7.16 (m, Ar-H), 7.4 (2H, t, Ar-H_c), 6.8 (2H, t, Ar-H_d), 2.47(3H , s, CH_3-S-), 8.1(s, -N=CH), 5.0(C-OH)

2(c)	1582 (C=N str.), 756 (mono substituted benzene) , 3420 OH-stretch) , 3126 (=CH str.), 3020 (Ar-H), 1250 (N-N=C str.), 690 (C-S-C str.)	7.5-7.1(m, Ar-H), 2.47 (3H, s, CH_3-S-), 8.1 (s,N=CH) , 6.8(2H, d ,Ar-H), 5.0(C-OH,aromatic)
2(d)	1603,1582(C=N str.), 1621 (C=C stretch), 1269, 756 (mono substituted benzene), 1615 (N=C stretch), 1120 (C-S –C stretch), 1587 (N-N=C stretch) , 698 (C-Cl stretch)	7.5-7.1(m, Ar-H), 2.47 (3H, s, CH_3-S-), 8.1 (s,-N=CH) , 6.8(2H, d ,Ar-H),7.6(2H, t, Ar-H)
2(e)	1681 (C=C stretch), 1311 (C-N stretch), 1641 (N=C stretch), 1066 (C-S stretch), 1575 (C=N-N stretch), 1534 (C-NO_2 stretch) , 1582 (C=N) , 759 (monosub- stituted benzene) , 696 (C-S-C)	7.4-7.1(m, Ar-H), 2.47 (3H, s, CH_3-S-), 8.1 (s,N=CH) , 7.9(2H, t , Ar-H), 8.2 (2H, t, Ar-H)
2(f)	1600, 1580(C=N str.), 750 (mono substituted benzene) , 3272, 3174 (-NH- str.),3127,3109 (=CH- str.), 3060, 3030 (Ar-H), 1245(N-N=C str.), 690 (C-S-C str.)	7.4-7.1(m, Ar-H), 2.47 (3H, s, CH_3-S-), 8.1 (s,N=CH) , 6.8(2H, t ,Ar-H),7.5(2H, t, Ar-H),3.73 (s, 3H, -OCH3).
2(g)	1603, 1582(C=N), 759 (mono substituted benzene), 3272, 3172 (-NH str.), 3127, 3109 (=CH str.), 3064, 3030 (Ar-H), 1247(N-N=C str.), 696 (C-S-C str.)	7.4-7.1(m, Ar-H), 2.47 (3H, s, CH_3-S-), 7.5 (s,N=CH) , 6.3(2H, d , furan).
Parent-3	1585 (C=N-N str.), 3272, 3172 (-NH), 3127, 3109 (=CH), 3064,3030 (Ar-H), 1247 (N-N=C str.), 696 (C-S-C str.)	7.34 (1H, s ,Ar-H), 2.46 (3H, s, CH_3-S-) , 7.21(1H ,d , Ar-H), 7.36(1H, d, Ar-H), 2.0(s, -NH_2).
3(a)	3137, 3115 (Ar-H), 1604 (C=C str.), 1275 (N-N=C str.), 1582(C=N str.) , 1247(N-N=C str.), 696 (C-S-C str.)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36(1H, d, Ar-H_b), 2.47 (3H, s, CH_3-S-), 7.6(2H, q, Ar-H), 7.3(3H, t, Ar-H), 8.1(s, -N=CH).
3(b)	1603, 1582(C=N str.), 3411(OH-stretch) , 3127,3109 (=CH- str.), 3054,3020 (Ar-H str.), 1250 (N-N=C str.), 690 (C-S-C str.)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36(1H, d, Ar-H_b), 6.8 (2H, t, Ar-H_d), 2.47(3H , s, CH_3-S-), 8.1(s, N=CH), 5.0(C-OH)
3(c)	1603 (C=N), 756 (mono substituted benzene) , 3420 (Ar-OH-stretch) , 3126,3100 (=CH- str.), 3054, 3020 (Ar-H), 1250 (N-N=C str.) , 690 (C-S-C str.)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36(1H, d, Ar-H_b), 7.1 (1H, t, Ar-H) 6.8 (2H, t, Ar-H_d), 2.47(3H , s, CH_3-S-), 8.1(s, N=CH), 5.0(C-OH)
3(d)	1582(C=N), 1621 (C=C stretch), 1269 cm-1, 1615 (N=C stretch), 1120 (C-S-C stretch), 1580 (N-N=C stretch) , 690 (C-Cl stretch)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36(1H, d, Ar-H_b), 7.3 (2H, t, Ar-H), 7.6 (2H, t, Ar-H), 2.47(3H , s, CH_3-S-), 8.1(s, N=CH).
3(e)	1680 (C=C stretch), 1310 (C-N stretch), 1630 (N=C stretch), 1066 (C-S stretch), 1570 (C=N-N stretch), 1530 (C-NO_2 stretch), 1582(C=N str.), 694 (C-S-C str.)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36 (1H, d, Ar-H_b), 2.47 (3H, s, CH_3-S-), 8.1 (s,N=CH) , 7.9(2H, t , Ar-H), 8.2 (2H, t, Ar-H)

3(f)	1600, 1580(C=N str.), 3272,3174 (-NH str.), 3127,3109 (=CH- str.), 3060, 3030 (Ar-H), 1235(N-N=C str.), 685 (C-S-C str.)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36(1H, t, Ar-H_b), 7.5(2H,t ,Ar-H), 6.8 (2H, t, Ar-H), 2.47 (3H, s, CH_3-S-) , 3.74 (s, 3H, -OCH3)
3(g)	1603 (C=N str.), 272,3172 (-NH str.) ,3127, 3109 (=CH str.), 3030 (Ar-H), 1247(N-N=C str.), 696 (C-S-C str.)	7.34 (1H, s, Ar-H_a), 7.21 (1H, d, Ar-H_c), 7.36(1H, t, Ar-H_b), 2.47 (3H, s, CH_3-S-), 7.5 (s,-N=CH) , 6.3(2H, d , furan), 7.4(1H, d, furan).

Results of Antifungal Activity

Table: 4 Zone of inhibition (diameter in mm) of Synthesized compounds

Zone of inhibition by agar well diffusion (diameter in mm)						
Compound Code	***Aspergillus niger***			***Candida albicans***		
	125 µg/100µL	***250*** µg/100µL	***500*** µg/100µL	***125*** µg/100µL	***250*** µg/100 µL	***500*** µg/100µL
1(a)	-	12	16	-	14	18
1(b)	-	11	15	-	12	17
1(c)	-	13	16	10	13	15
1(d)	-	10	12	-	-	12
1(e)	-	-	10	-	-	13
1(f)	11	12	16	-	15	19
1(g)	-	-	14	11	13	17
2(a)	-	-	13	12	14	17
2(b)	-	14	16	-	-	12
2(c)	12	14	16	11	13	18
2(d)	10	13	15	-	-	11
2(e)	-	10	12	-	11	13
2(f)	10	12	13	-	15	17
2(g)	-	-	11	-	-	13
3(a)	-	11	13	-	-	10
3(b)	-	12	14	-	-	12
3(c)	-	-	12	12	15	19
3(d)	-	10	13	-	11	13
3(e)	-	13	16	-	-	12
3(g)	-	-	13	-	-	11
Control	-	-	-	-	-	-
Fluconazole	22	28	36	24	30	38

(–), indicates there was no observed zone of inhibition

5. Conclusion

In the present work total 21 compounds were synthesized from three parent compounds. These parent compounds were used as nucleus for the synthesis of various Schiff base derivatives like 1 (a-g),2(a-g),3(a-g). All synthesized compounds were identified for anti-bacterial and anti-fungal activity. Among the compounds tested, 1(g), 2(d), 2(g), 3(g), exhibited good inhibitory activity against *B. subtilis and S. aureus*. Compound 1(c), 2(a), 2(e), 3(c), showed good inhibitory activity against *E. coli.*. Ampicillin was used as control for antibacterial activity against *S. aureus, B. subtilis and E. coli.*. Antifungal activity of compounds against the two important fungal strain *Aspergillus niger and Candida albicans* using well diffusion method. Fluconazole was used as standard drug for comparison of results. Compound 3(c) was found to be very good antifungal agent for *A. niger*, whereas compound 1(c), 1(f), 2(b), 2(d), showed moderate activity. Compounds 1(g), 2(a), 2(c), 3(c) were found to be very good antifungal agent for *C. albicans*. whereas compound 1(a), 1(b), 1(f), 2(f), showed moderate activity.

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