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Synthesis and antimicrobial study of some novel Schiff bases and formazans

J. H. Solanki[a] and S. I. Marjadi[b]

[a]*Department of Chemistry, Government College Daman, 396210*
[b]*B. K. M. Science College, Valsad, 396001*

ABSTRACT

A new series of Schiff bases and formazan derivatives having piperazine moiety have been prepared. Various Schiff bases have been prepared from N-ethylpiperazine on condensation with 4-chloroaniline and subsequent reaction with various aldehydes. These Schiff bases are then coupled with various aryl diazonium chlorides in pyridine to give formazan derivatives.

Keyword: Schiff base, formazan, *N*-ethylpiperazine.

INTRODUCTION

Schiff base are important compounds owing to their wide range of biological activities and industrial applications. They have been found to possess various pharmacological activities such as antimalarial[**1]**, anticancer[**2]**, antibacterial[**3]**, antifungal[**4]**, antitubercular[**5]**, anti-inflammatory[**6]**, antiviral[**7]**, etc. The presence of azomethine group in schiff base has been found to decrease the toxicity considerably.

Formazans are known to exhibit various pharmacological applications and are also used as dyeing agents[**8]** since they belong to azo dye family. Formazans form tetrazolium salts when they are oxidised[**9]**. The thiozolyl/ oxazolyl indole formazans were tested for anti-inflammatory[**10]** activity. Formazans show potent antimicrobial properties11 and the same have been found to be potential antifungal[**12]**, anti-viral[**13]**, anticancer[**14]** and anti-HIV agents[**15]**.

MATERIALS AND METHODS

3.1 General
All chemicals were purchased from Sigma Aldrich, Merck and Fluka. Solvents used were of analytical grade. All reactions were routinely checked by TLC. TLC was performed on aluminum-backed silica gel plates (silica gel 60 F254 grade, Merck DC) with spots visualized by UV light. Melting points were determined in open capillary tubes and are uncorrected. IR spectra were recorded in KBr on a Shimadzu 8400S FTIR spectrophotometer. ^{1}H NMR spectra were recorded on a Hitachi 300 MHz using TMS as an internal standard and elemental analysis had been carried out on Perkin-Elmer CHNS-2400.

*3.2 4-(4-ethylpiperazin-1-yl) benzenamine **(1)***
A mixture of *N*-ethylpiperazine (0.1 mmol) and *p*-chloroaniline (0.1 mmol) and anhydrous K_2CO_3 in absolute alcohol (20 mL) was refluxed for 4 h. The resultant mixture was cooled to room temperature and poured into ice-cold water with stirring. The separated solid was filtered, washed with water and recrystallized from ethanol[**16**].

*3.3 General synthetic procedure for Schiff bases **(2a-2d)***
A mixture of 4-(4-ethylpiperazin-1-yl)benzenamine (0.1 mmol) and benzaldehyde (0.1 mmol) in absolute alcohol (20 mL) was refluxed for 2 h. After the completion of reaction it was poured into ice-cold water with stirring. The

solid product obtained was filtered, washed with water and recrystallized from ethanol. Similarly, the remaining Schiff bases as shown in the scheme were prepared (**2a-2d)**[17].

*3.3.1 N-benzylidene-4-(4-ethylpiperazin-1-yl)benzenamine **(2a)***
Yield 77%, m.p. 180-182 °C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{19}H_{23}N_3$: C,77.78%, H,7.90%, N,14.32%, Found: C,77.78%, H,7.94%, N,14.35%.

*3.3.2 N-(4-chlorobenzylidene)-4-(4-ethylpiperazin-1-yl)benzenamine **(2b)***
Yield 72%, m.p. 100-101 °C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{19}H_{22}Cl_3N_3$: C,68.67%, H,6.72%, N,13.35%, Found: C,68.69%, H,6.74%, N,13.37%.

*3.3.3 N-(4-methoxybenzylidene)-4-(4-ethylpiperazin-1-yl)benzenamine **(2c)***
Yield 68%, m.p. 141-145 °C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{20}H_{25}N_3O$: C,74.27%, H,7.79%, N,12.99 %, Found: C,74.28%, H,7.80 %, N,13.00 %.

*3.3.4 N-(3-nitrobenzylidene)-4-(4-ethylpiperazin-1-yl)benzenamine **(2d)***
Yield 64%, m.p. 200-201 °C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{19}H_{23}N_4O_2$: C,67.44%, H,6.55%, N,16.56 %, Found: C,67.47%, H,6.57 %, N,16.58 %.

*3.4 General synthetic procedure for Formazans **(3a-3p)***
A cold stirred solution of various *para* substituted anilines (0.01 mmol) previously dissolved in aqueous HCl (10 mL) was diazotized over crushed ice by drop wise addition of cold aqueous solution of $NaNO_2$ (2.5 g) with stirring till a clear solution of diazonium salt of respective amine was obtained. The temperature was at 0-5 ^{o} C. It was further stirred until the positive test of nitrous acid on starch-iodide paper was obtained. This mixture was then poured into a cold solution of **2a-2d** (0.01 mmol) dissolved in dry pyridine (5.0 mL). The reaction mixture was further stirred for 2 h maintaining temperature 0-5 ^{o} C. The mixture was then poured into water with continuous stirring. The resultant dark coloured mass was filtered and washed with water till free from pyridine, dried and recrystallized from ethanol to obtain **3a-3p**[18].

*3.4.1 N-(2-chlorophenylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)benzamidine **(3a)***
Yield 58.64%, m.p. 215-220 ^{0}C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{25}H_{26}ClN_5$: C,69.51%, H,6.07%, N,16.21 %, Found: C,69.53%, H,6.09 %, N,16.22 %.

*3.4.2 N-(p-tolylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)benzamidine **(3b)***
Yield 50.89%, m.p. 160-165 ^{0}C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{29}N_5O$: C,73.05%, H,6.84%, N,16.38 %, Found: C,73.05%, H,6.86 %, N,16.39 %.

*3.4.3 N-(2-methoxyphenylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)benzamidine **(3c)***
Yield 50.24%, m.p. 70 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{29}N_5O$: C,73.04%, H,6.84%, N,16.38 %, Found: C,73.06%, H,6.86 %, N,16.39 %.

*3.4.4 N'-(4-(4-ethylpiperazin-1-yl)phenyl)-N-(phenylimino)benzamidine **(3d)***
Yield 59.46%, m.p. 220-225 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{25}H_{27}N_5$: C,74.54%, H,6.85%, N,17.62 %, Found: C,75.56%, H,6.88%, N,17.64 %.

*3.4.5 N-(2-Chlorophenylimino)-4-Chloro-N'-(4-(4-ethylpiperazin-1-yl)phenyl)benzamidine **(3e)***
Yield 52.87%, m.p. 60-65 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{25}H_{25}Cl_2N_5$: C,64.38%, H,5.40%, N,15.20 %, Found: C,64.39%, H,5.43 %, N,15.23 %.
*3.4.6 N-(p-tolylimino)-4-chloro-N'-(4-(4-ethylpiperazin-1-yl)phenyl)benzamidine **(3f)***

Yield 55.68%, m.p. 150-160 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{28}ClN_5O$: C,67.59%, H,6.11%, N,15.16 %, Found: C,67.61%, H,6.13 %, N,15.18 %.

*3.4.7. N-(2-methoxyphenylimino)-4-chloro-N'-(4-(4-ethylpiperazin-1-yl)phenyl)benzamidine **(3g)***
Yield 54.12%, m.p. 275-285 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{28}ClN_5O$: C,67.59%, H,6.11%, N,15.16 %, Found: C,67.61%, H,6.13 %, N,15.18 %.

*3.4.8 4-chloro-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-N-(phenylimino)benzamidine **(3h)***
Yield 60.45%, m.p. 195-200 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{25}H_{26}ClN_5$: C,69.51%, H,6.07%, N,16.21 %, Found: C,69.53%, H,6.08 %, N,16.23 %.

*3.4.9 N-(2-chlorophenylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-4-methoxybenzamidine **(3i)***
Yield 70.35%, m.p. 170 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{28}ClN_5O$: C,67.59%, H,6.11%, N,15.16 %, Found: C,67.58%, H,6.12 %, N,15.18 %.

*3.4.10 N-(p-tolylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-4-methoxybenzamidine **(3j)***
Yield 61.00%, m.p. 55 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, CDCl3): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{27}H_{31}N_5O_2$: C,70.87%, H,6.83%, N,15.31 %, Found: C,70.89%, H,6.85 %, N,15.33 %.

3.4.11 *N-(2-methoxyphenylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-4-methoxybenzamidine **(3k)***
Yield 55.68%, m.p. 220-225 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{27}H_{31}N_5O_2$: C,70.87%, H,6.83%, N,15.31 %, Found: C,70.88%, H,6.85 %, N,15.34 %.

*3.4.12 N'-(4-(4-ethylpiperazin-1-yl)phenyl)-4-methoxy-N-(phenylimino)benzamidine **(3l)***
Yield 54.12%, m.p. 60-65 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{29}N_3O$: C,73.04%, H,6.84%, N,16.38 %, Found: C,73.07%, H,6.86 %, N,16.39 %.

*3.4.13 N-(2-chlorophenylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-3-nitrobenzamidine **(3m)***
Yield 60.45%, m.p. 150-160 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{25}H_{25}ClN_6O_2$: C,62.97%, H,5.97%, N,17.62 %, Found: C,62.97%, H,5.29 %, N,17.63 %.

*3.4.14 N-(p-tolylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-3-nitrobenzamidine **(3n)***
Yield 70.35%, m.p. 275-285 ^{0}C, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{28}N_6O_3$: C,66.09%, H,5.97%, N,17.78 %, Found: C,66.09%, H,5.99 %, N,17.79 %.

*3.4.15 N-(2-methoxyphenylimino)-N'-(4-(4-ethylpiperazin-1-yl)phenyl)-3-nitrobenzamidine **(3o)***
Yield 61.00%, m.p. 215-220 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{26}H_{28}N_6O_3$: C,66.09%, H,5.97%, N,17.78 %, Found: C,66.10%, H,5.99 %, N,17.79 %.

*3.4.16 N'-(4-(4-ethylpiperazin-1-yl)phenyl)-3-nitro-N-(phenylimino)benzamidine **(3p)***
Yield 61.00%, m.p. 150-160 ^{0C}, IR (KBr, cm^{-1}): 3570 (NH-CH_3), 1542 (N=CH), ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.41 (m, 10H, -CH_2 of piperazine), 2.43 (dd, 1H, -CH_2), 1.01 (d, 3H, -CH_2), 8.40 (s, 1H, N=CH), 6.8 (m, Ar-H, 1-8H), Anal. Calcd. for $C_{25}H_{26}N_6O_2$: C,67.86%, H,5.92%, N,18.99 %, Found: C,67.88%, H,5.94 %, N,19.01%.

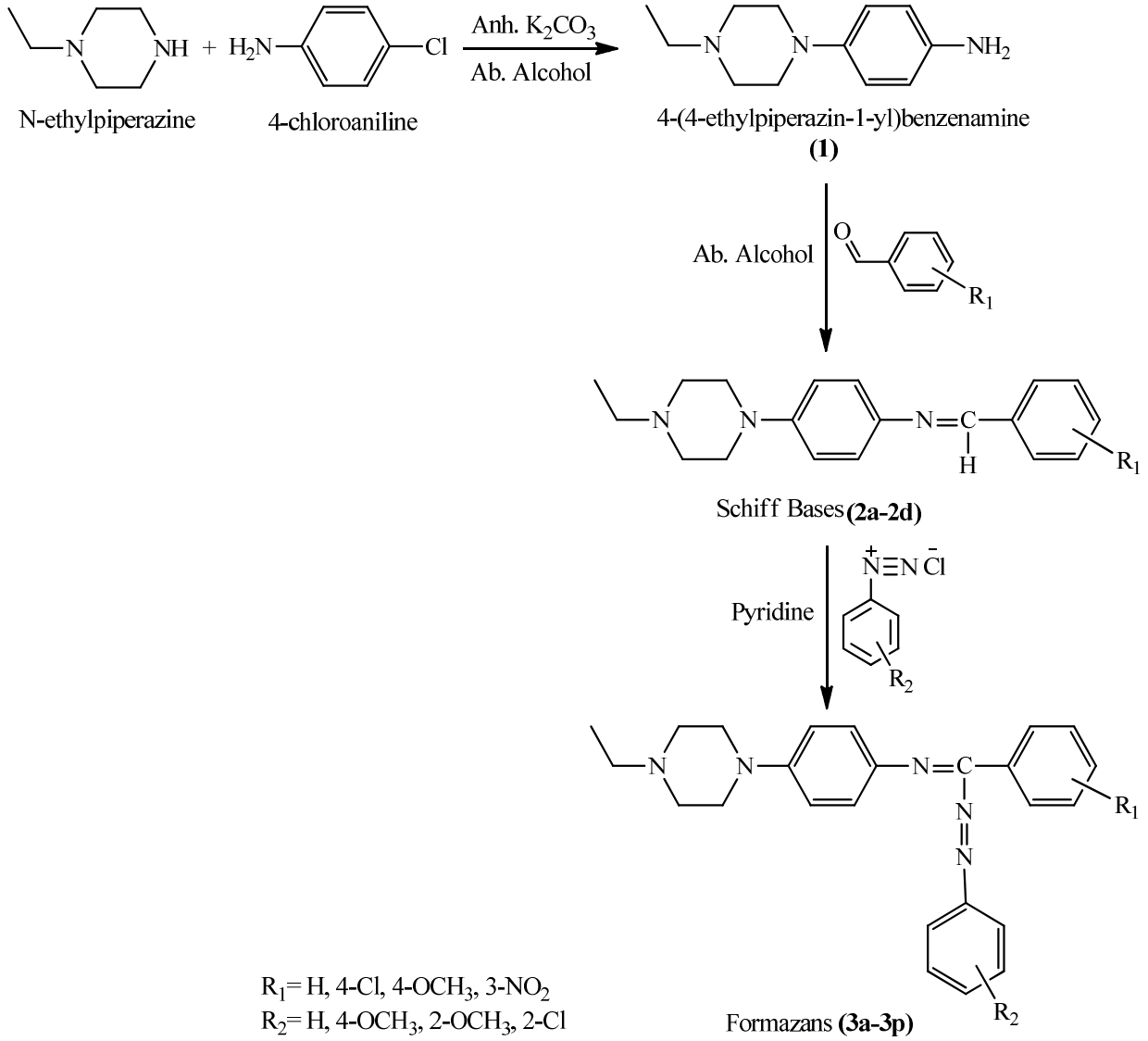
3.5 Microbiology

The antimicrobial activity of synthesized analogs has been carried out against two Gram-positive bacteria (*S. Aureus* ATCC 6538P and *S. Pyrogenus* ATCC 8668), two Gram-negative bacteria (*E. Coli.* ATCC 8739 and *P.Aeruginosa* ATCC 9027) and against three fungal species (*C. Albicans* ATCC 10231, *A. Niger* ATCC16404 and *A. Clavatus* ATCC 9600). Here, ampicilline, chloramphenicol, ciprofloxacin (100 µg/disk) were used as control drugs for antibacterial activity while nystatin and griesofulvin for antifungal activity[19].

RESULTS AND DISCUSSION

2.1 Chemistry

The synthetic route for the target analogs **2a-2d** and **3a-3p** is outlined in Scheme 1. The initial analog 4-(4-ethylpiperazin-1-yl)benzenamine (**1**) was synthesized by the condensation reaction of *N*-ethylpiperazine and 4-chloroaniline. Schiff base **2a-2d** derivatives were synthesized by reacting analog **1** with various aldehydes. The condensation of **2a-2d** with various diazonium salts to form final formazans derivatives **3a-3p.**



Scheme 1. Synthetic rout for Formazan derivatives 3a-3p

2.2 Pharmacology

2.2.1 Antibacterial Activity

The *in vitro* results of antimicrobial activity of the newly synthesized compounds **2a-2d** and **3a-3p** are presented in Table 1 as a minimal inhibitory concentration (MIC). Some of the compounds displayed moderate to good inhibition in the range of 128-256 µg/mL. Compound **2b** having 4-chloro substituent, compound **2d** having 3-nitro substituent showed moderate activity (MIC 256 µg/mL) against *S. aureus* when compared with Ampicillin. Compound **2b** having 4-chloro substituent, compound **2c** having 4-methoxy displayed good activity (MIC 256 µg/mL) against *S. pyogenus* when compared with Ampicilline. Compound **2d**, having 3-nitro substituent, showed better activity (MIC 128 µg/mL) against *E. coli* when compared with Ampicilline. Compounds **2b** and **2d** having 4-chloro and 3-nitro respectively showed moderate activity (MIC 256 µg/mL) against *P. aeruginosa* when compared with Ampicilline.

Table-1: *In-vitro* antibacterial and antifungal activity of compounds 3a-3p

Entry	R_1	R_2	Minimum Inhibitory Concentrations (μg/mL)						
			Gram-positive bacteria		Gram-negative bacteria		Fungus		
			S. aureus	*S. pyogenus*	*E. coli*	*P. aeruginosa*	*C. albicans*	*A. niger*	*A. clavatus*
2a	H	-	512	512	512	512	512	512	512
2b	4-Cl	-	256	256	256	256	512	512	256
2c	4-OCH_3	-	512	256	512	512	512	256	256
2d	3-NO_2	-	256	512	128	256	512	256	512
3a	H	2-Cl	512	512	512	512	512	512	256
3b	H	4-OCH_3	128	128	128	128	512	512	512
3c	H	2-OCH_3	128	512	512	128	256	512	128
3d	H	H	512	256	128	128	256	128	256
3e	4-Cl	2-Cl	256	128	256	256	256	512	256
3f	4-Cl	4-OCH_3	256	128	128	128	128	256	512
3g	4-Cl	2-OCH_3	256	512	512	512	512	512	512
3h	4-Cl	H	256	512	128	128	128	256	256
3i	4-OCH_3	2-Cl	128	256	512	256	256	256	256
3j	4-OCH_3	4-OCH_3	512	512	512	256	512	512	512
3k	4-OCH_3	2-OCH_3	256	512	512	512	512	512	512
3l	4-OCH_3	H	256	512	128	128	128	256	256
3m	3-NO_2	2-Cl	128	256	512	256	256	256	256
3n	3-NO_2	4-OCH_3	512	512	512	256	512	512	512
3o	3-NO_2	2-OCH_3	512	512	512	256	512	512	512
3p	3-NO_2	H	256	512	512	512	512	512	512
Ampicilin	-	-	250	100	100	100	-	-	-
Chloramphenicol	-	-	50	50	50	50	-	-	-
Ciprofloxacin	-	-	50	50	25	25	-	-	-
Nystatin	-	-	-	-	-	-	100	100	100
Griesofulvin	-	-	-	-	-	-	500	100	100

While formazan derivatives **3b** (R_1= H, R_2= 4-OCH_3), **3c** (R_1= H, R_2= 2-OCH_3), **3i** (R_1= 4-OCH_3, R_2= 2-Cl) and **3m** (R_1= 3-NO_2, R_2= 2-Cl) displayed highest inhibition (MIC 128 μg/mL) against *S. aureus* when compared with ampicilline. Moreover, analogs **3e**, **3f**, **3g**, **3h**, **3k** and **3l** with presence of 4-chloro and 4-methoxy substituents at R_1 position displayed moderate activity (MIC 256 μg/mL) against *S. aureus*. Compounds **3b, 3e** and **3f** displayed moderate activity (MIC 128 μg/mL) against *S. pyogenus*. Analogs **3b, 3d, 3f, 3h** and **3l** showed moderate activity (MIC 128 μg/mL) against Gram-negative bacteria *E.Coli*. Compounds **3b, 3c, 3d, 3f, 3h** and **3l** showed moderate activity (MIC 128 μg/mL) against *P. aeruginosa*.

2.2.2 Antifungal Activity

The results showed that some of the synthesized schiff base derivatives **2b, 2c** and **2d** were found to be moderately active (MIC 256 μg/mL) when compared with griseofulvin. While some formazan derivatives **3f, 3h** and **3l** showed excellent activity with MIC 128 μg/mL against *C. albicans*. While compounds **3c, 3d, 3e , 3i** and **3m** displayed moderate activity (MIC 256 μg/mL) against *C. albicans*.

CONCLUSION

In conclusion, we report the synthesis of various Schiff base and formazan derivatives. The bioassay results reveal that the many of the synthesized final formazan analogs have shown remarkably high activity against the Gram-positive bacteria, Gram-negative bacteria and fungal strains as compare with the standards.

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