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SYNTHESIS AND ANTIMICROBIAL EVALUATION OF NOVEL SCHIFF'S BASES DERIVED FROM 2, 6-DICHLORO-4-TRIFLUORO METHYL ANILINE

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ABSTRACT

Schiff bases are the extremely useful class of organic compounds that are widely synthesized by condensation of primary amines with carbonyl compounds. Schiff bases are the appropriate compounds having unrivalled application in organic and inorganic chemistry. Schiff bases and their metal complexes are classified for their broad range of biological importance including antibacterial, antifungal, antiviral, anticancer, anti-HIV and antipyretic properties. Considering the numerous applications of Schiff's bases in various fields of chemistry, there has been tremendous interest in developing efficient methods for their preparation.

In the present investigation, we have designed a modish series of Schiff's bases via reaction between various substituted aromatic vinyl aldehydes and 2,6- dichloro 4-trifluromethyl aniline in presence of acetic acid. These newly synthesized Schiff's bases were characterized by spectral analysis and all compounds were screened for their antimicrobial activities.

Keywords: Schiff bases, Metal complexes, Substituted aromatic vinyl aldehydes, 2, 6 dichloro 4-fluromethyl aniline.

1. INTRODUCTION

The chemistry of Schiff base-containing compounds has been an engrossing domain of study from the classical era. Subsequently, Schiff bases comprise a remarkable genre of compounds for designing of most innovative medicinal scaffolds and pesticidal agents [1-3]. Schiff bases are broadly determined organic molecules. They are extensively utilized for numerous commercial purposes and also as starting moieties to synthesize several vital drugs to medicate the lethal diseases including cancer, HIV, tuberculosis and so forth [4-6].

These compounds were initially reported by German chemist 'Hugo Schiff' in 1864 and named Schiff bases [7]. These compounds have imine or azomethine (-C=N-) functional group in their skeleton that contains a nitrogen atom linked to an aryl or alkyl group [8]. Usually these are the products of facile condensation of primary amines with carbonyl compounds [9]. Schiff bases in a broad sense are generally represented as follows.

The chemistry of Schiff bases has received considerable attentiveness owing to their synthetic and incredible pharmacological properties. In recent few decades, tremendous research has been carried over Schiff bases and several magnificent novel Schiff bases are emerged out which exponentially possess milestone therapeutic values such as anticancer [10], analgesic [11], anti-microbial, leishmanicidal, antioxidant [12], anti-convulsant [13], antitubercular [14], anti-inflammatory [15], anthelmintic [16] and so forth.

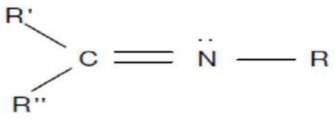


Fig. 1: General Structure of Schiff base

Apart from biological properties, they are also recognized as catalysts, dyes, pigments, photo stabilizers [17], anti-corrosive agents [18] and as synthetic intermediates in organic as well as pesticides synthesis [19]. The literature review revealed that metal complexes exhibit significant biological activity than any other free organic molecules [20]. However Schiff bases can be further utilized to develop milestone complexes using transition metals. It is exhibited by recent studies that the therapeutic potency of Schiff bases increases by chelation [21].

Schiff bases have diversified as an essential category of ligands in co-ordination chemistry and facilely liable to

coordinate metallic ions by azomethine nitrogen atom [22]. They have also played a dazzling character in the evolution of coordination chemistry and are involved as a prestigious element in the advancement of inorganic biochemistry and optical potentiality [23].

Schiff bases are extensively researched molecules and popularly known for their selectivity, sensitivity, synthetic flexibility towards the central metallic ion, and the presence of an azomethine group in Schiff base that helps to describe the mechanism of transformation reactions in biological system [24, 25]. They are also classified for their broad applications in the field of polymer. Several diversified imine derivatives can be employed to acquire conductive polymeric materials [26]. Tridentate Schiff base organo-cobalt complexes act as a pioneer in emulsion polymerization and co-polymerization of dienyl and vinyl monomers [27].

Considering all these applications, we have attempted to design several novel Schiff bases derived from 2, 6 dichloro-4 triflouromethyl aniline, halovinyl aldehydes of succinic and glutaric cyclic imides for the sake of their biological properties.

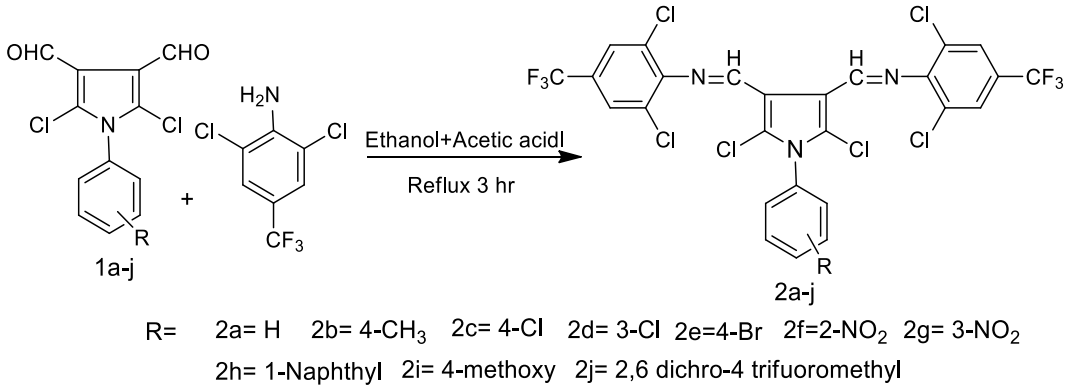
2. MATERIAL AND METHODS

AR Grade chemicals were utilized for the preparation of all novel compounds. Melting points of all synthetically developed compounds were determined by the open capillary method and were found uncorrected. The reaction was monitored by TLC which was accomplished by using pre-coated silica gel aluminum plates with a mixture of hexane: ethyl acetate as solvent. FTIR spectra are recorded on Perkin-Elmer spectrum. H^1NMR and ^{13}C-NMR spectra are recorded on Bruker (Advance HD III) 500 MHz spectrometer with DMSO-d^6 solvent and TMS was used as internal reference (chemical shift in δ ppm). However mass spectra were recorded on Bruker (Impact HD) mass spectrometer using dlc-ms 600mz method.

2.1. General method of synthesis of N,N'-((2,5-dichloro-1-(substituted-phenyl)-1H-pyrrole -3,4-diyl) bis (methanylylidene)) bis (2,6-dichloro-4-(trifluoromethyl) aniline) (2a-j)

Vinyl aldehyde (0.01mol) (1a-j) was dissolved in methanol (10ml). Then 2, 6-dichloro-4-trifluoromethyl aniline (0.02mol) was added vigorously in presence of catalytic amount of acetic acid. The mixture was refluxed in a water bath for 3 hours and the reaction was monitored by TLC. After completion of the reaction, the mixture was cooled at room temperature and worked up in chilled water to afford solid precipitate. Ultimately it was filtered off, washed with water, dried, and recrystallized from ethanol (Scheme-1).

By following the same experimental procedure, the remaining title compounds (2a-j) are prepared.



Scheme 1: Synthesis of a novel series of Schiff bases from halovinyl aldehyde of succinimides

2.1.1. N,N'-((2,5-dichloro-1-phenyl-1H-pyrrole-3,4-diyl) bis(methanylylidene)) bis (2,6-dichloro-4-(trifluoromethyl)aniline) (2a)

M.F: $C_{26}H_{11}Cl_6F_6N_3$, M.W: 692, Yield 80%, M.P. 73ºC. **C, H, N Elem. Anal.** Cal: C, 45.12; H, N, 6.07. Obs: C, 45.08; H, N, 6.01. **FTIR (KBr) cm^{-1}:** 1672 (C=N stretching), 2948 (C-H stretching of N=C-H), 1293 (C-N stretching of cyclic imine), 1400-1600 (Aromatic C=C stretching, 3 peaks), 756 (C-Cl stretching), 1130 (C-F stretching), 907 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 7.78 (s, 5H, *J* = 7.5Hz), 8.01 (s, 4H, Ar-H J= 2.3 Hz, 7.30), 6.86 (s, 2H, N=C-H).

2.1.2. N,N'-((2,5-dichloro-1-(p-tolyl)-1H-pyrrole-3,4-diyl) bis (methanylylidene))bis (2,6-dichloro-4-(trifluoromethyl) aniline)(2b)

M.F: $C_{27}H_{13}Cl_6F_6N_3$, M.W: 702.91, Yield 85%, M.P. 198°C**, C, H, N Elem.** Cal: C, 45.193; H, 1.86; N, 5.95. Obs: C, 45.183; H, 1.78; N, 6.03. **FTIR (KBr) cm^{-1}:** 1701 (C=N stretching), 2948 (C-H stretching of N=C-H), 2829 (C-H stretching of CH_3 group), 1035 (C-H bending of CH_3 group) 1293 (C-N stretching of cyclic imine), 1400-1600 (Aromatic C=C stretching, three peaks), 680 (C-Cl stretching), 1130 (C-F stretching), 910 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 7.30 (d, 2H, *J* = 7.5Hz), 7.45 (d, 2H, *J* =7.5Hz), 7.70 (s, 4H, Ar-H), 6.89 (s, 1H *J*=2.3 Hz.), 2.80 (s, 3H, CH_3).

2.1.3. N,N'-((2,5-dichloro-1-(4-chlorophenyl)-1H-pyrrole-3,4-diyl) bis (methanylylidene))bis (2,6-dichloro-4-(trifluoromethyl) aniline) (2c)

M.F: $C_{26}H_{10}Cl_7F_6N_3$, M.W: 726.53 Yield 88%, M.P.105 °C. **C, H, N Elem. Anal.** Cal: C, 42.98; H, 1.39; N, 5.78. Obs: C, 42.90; H, 1.42; N, 5.69. **FTIR (KBr) cm^{-1}:** 1701 (C=N stretching), 2981 (C-H stretching of N=C-H), 1277 (C-N stretching of cyclic imine), 1400-1550 (Aromatic C=C stretching), 829 (C-Cl stretching), 1164 (C-F stretching), 1005 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 7.30 (d, 2H, *J* = 7.5Hz), 7.45 (d, 2H, *J* =7.5Hz), 7.70 (s, 4H, Ar-H), 6.9 (s, 2H, Ar-N=C-H).
^{13}C-NMR (DMSO-d^6 δ ppm):127-130 (d, 6C, Ar-C), 131-136 (s, 8C Ar-C) 140-s, 5C, Ar-C), 170-175 (d, 2C N=C-), 125-130 (s, 4C, CF_3, A-C), 120-125 (s, 1C, Ar-C). **HRMS (ESI):** calculated: 726.53 found: 729.06.

2.1.4. N,N'-((2,5-dichloro-1-(3-chlorophenyl)-1H-pyrrole-3,4-diyl) bis (methanylylidene)) bis (2,6-dichloro-4-(trifluoromethyl) aniline) (2d)

M.F: $C_{26}H_{10}Cl_7F_6N_3$, M.W: 726.53, Yield 80%, M.P 98 °C.

2.1.5. N,N'-((1-(4-bromophenyl)-2,5-dichloro-1H-pyrrole-3,4-diyl)bis(methanylylidene))bis (2,6-dichloro-4-(trifluoromethyl)aniline)(2e)

M.F: $C_{26}H_{10}BrCl_6F_6N_3$, M.W: 770.99, Yield 87 %, M.P. 159°C. **FTIR (KBr) cm^{-1}:**1701 (C=N stretching), 2948 (C-H stretching of N=C-H), 1315, (C-N stretching of cyclic imine), 1450-1600, (Aromatic C=C stretching, three peaks), 711 (C-Cl stretching), 510 (C-Br stretching), 1131 (C-F stretching), 1010 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 7.30 (d, 2H, *J* = 7.5Hz), 7.45 (d, 2H, *J* =7.5 Hz), 7.81(s, 4H, Ar-H), 6.90 (s, 2H, Ar-N=C-H).

2.1.6. 2,6-dichloro-N-((2,5-dichloro-4-(((2,6-dichloro-4-(trifluoromethyl)phenyl)imino) methyl)-1-(2-nitrophenyl)-1H-pyrrol-3-yl) methylene)-4-methylaniline (2f)

M.F: $C_{26}H_{10}Cl_6F_6N_4O_2$, M.W: 742.15, Yield 85%, M.P. 105°C. **C, H, N Elem. Anal.** Cal: C, 42.37; H, 1.37; N, 7.60; Obs: C, 42.31; H, 1.30; N, 7.54. **FTIR (KBr) cm^{-1}:** 1712 (C=N stretching), 2942 (C-H stretching of N=C-H) 1354 (C-N stretching of cyclic imine), 1450-1550 (Aromatic C=C stretching), 1383 cm^{-1} (NO_2 asymmetric stretching), 1522 (NO_2 symmetric stretching), 706 (C-Cl stretching), 1170 (C-F stretching), 1002 (C=C-H bending). ^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm): 8.10-8.31 (dd, 4H, Ar-H), 7.80 (s, 4H, Ar-H), 7.70 (s, 2H, Ar-N=C-H).

2.1.7. 2, 6-dichloro-N-((2,5-dichloro-4-(((2,6-dichloro-4-(trifluoromethyl) phenyl) imino) methyl)-1-(3-nitrophenyl)-1H-pyrrol-3-yl) methylene)-4-methylaniline (2g)

M.F: $C_{26}H_{10}Cl_6F_6N_4O_2$, M.W: 742.15 Yield 80%, M.P.158°C.

2.1.8. N,N'-((2,5-dichloro-1-(naphthalen-1-yl)-1H-pyrrole-3,4-diyl)bis (methanylylidene)) bis (2,6-dichloro-4-(trifluoro methyl) aniline) (2h)

M.F: $C_{30}H_{13}Cl_6F_6N_3$, M.W: 742.15 Yield 85 %, M.P. 125°C. **C, H, N Elem. Anal.** Cal: C, 48.55; H, 1.77; N, 5.66. Obs: C, 48.49; H, 1.71; N, 5.61. **FTIR (KBr) cm^{-1}:** 1701 (C=N stretching), 2937 (C-H stretching of N=C-H), 1293 (C-N stretching of cyclic imine), 1400-1600 (Aromatic C=C stretching), (C-Cl), 1181 (C-F), 1010 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 8.10 (s, 3H, Ar-H)**,** 7.70 (s, 4H, Ar-H *J*=7.5 Hz), 7.80 (s, 4H, Ar-H), 7.30 (2H, Ar-N=C-H).

2.1.9. N,N'-((2,5-dichloro-1-(4-methoxyphenyl)-1H-pyrrole-3,4-diyl)bis(methanylylidene)) bis(2,6-dichloro-4-(trifluoromethyl)aniline) (2i)

M.F: $C_{27}H_{13}Cl_6F_6N_3O$, M.W: 722.12, Yield 82%, M.P.128°C **C, H, N Elem. Anal.** Cal: C, 44.91; H, 1.81; N, 5.82.Obs: C, 44.88; H, 1.86; N, 5.77. **^{1}H-**

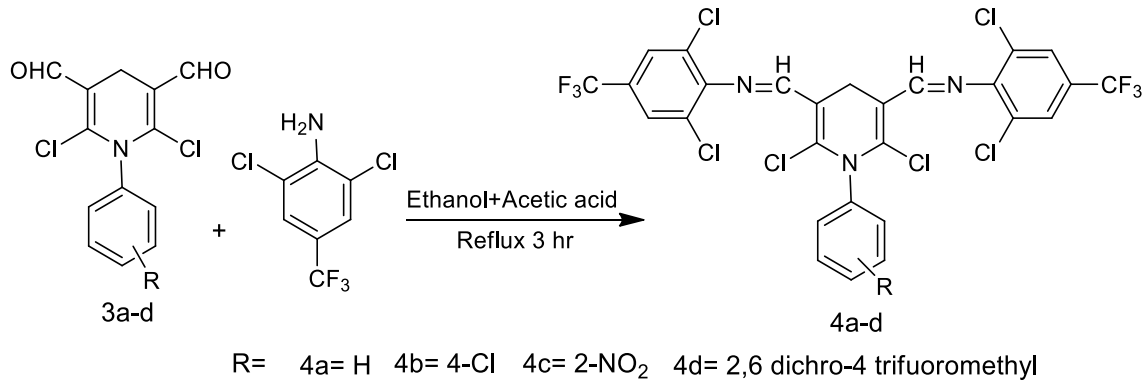
NMR (500 MHz, DMSO-d^6 δ ppm): 7.70 (dd, 2H, Ar-H, *J*=7.5 Hz), 7.30 (dd, 2H, Ar-H *J*=7.5 Hz), 7.80 (s, 4H, Ar-H), 6.30 (s, 2H, Ar-N=C-H), 3.73 (s, 3H, O-CH_3).

2.1.10. N,N'-((2,5-dichloro-1-(2,6-dichloro-4-(trifluoromethyl)phenyl)-1H-pyrrole-3,4-diyl) bis(methanylylidene))bis(2,6-dichloro-4-(trifluoromethyl)aniline) (2j)

M.F: $C_{27}H_8Cl_8F_9N_3$, M.W: 828.98.12, Yield 75%, M.P. 63 ºC. **C, H, N Elem. Anal. Cal:** C, 39.12; H, 0.97; N, 5.07. Obs: C, 39.09; H, 0.92; N, 5.01. **^{1}H-NMR (500 MHz, DMSO-d6 δ ppm):** 7.80 (s, 6H, Ar-H), 7.40 (s, 2H, Ar-N=C-H).

2.2. Synthesis of N,N'-((2,6-dichloro-1-aromatic substituted phenyl-1,4-dihydro pyridine-3,5-diyl) bis (methanyl ylidene)) bis (2,6-dichloro-4-(trifluoromethyl)aniline) (4a-d)

Vinyl aldehyde (3a-d) (0.01mol) was dissolved in methanol (10ml). Then 2, 6-dichloro-4-trifluoromethyl aniline (0.02mol) was added vigorously in presence of catalytic amount of acetic acid. The mixture was refluxed on water bath for 3 hours and the reaction was monitored by TLC. After completion of the reaction, the mixture was cooled at room temperature and worked up in chilled water to afford solid precipitate. Ultimately it was filtered off, washed with water, dried, and recrystallized from ethanol (Scheme 2).



Scheme 2: Synthesis of a novel series of Schiff bases from halovinyl aldehyde of glutarimides

2.2.1. N,N'-((2,6-dichloro-1-phenyl-1,4-dihydro-pyridine-3,5-diyl) bis (methanylylidene)) bis(2,6-dichloro-4-(trifluoromethyl)aniline) (4a)

M.F: $C_{27}H_{13}Cl_6F_6N_3$, M.W: 706.91, Yield 75%, M.P. 93ºC. **C, H, N Elem. Anal. Cal:** C, 45.93; H, 1.86; N, 5.95. Obs: C, 45.88; H, 1.79; N, 5.90.

2.2.2. N,N'-((2,6-dichloro-1-(4-chlorophenyl)-1,4-dihydropyridine-3,5-diyl) bis (methanylylidene))bis(2,6-dichloro-4-(trifluoromethyl) aniline)(4b)

M.F: $C_{27}H_{12}Cl_7F_6N_3$, M.W: 740.56, Yield 72%, M.P. 254ºC. C, H, N Elem. Anal. Cal: C, 43.79; H, 1.63; N, 5.67. Obs: C, 43.73; H, 1.63; N, 5.62. **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 7.80 (s, 4H, Ar-H), 7.10 (dd, 4H, Ar-H *J*=7.5 Hz) (s, 2H, Ar-N=C-H), 3.20 (s, 2H, CH_2).

2.2.3. N,N'-((2,6-dichloro-1-(2-nitrophenyl)-1,4-dihydropyridine-3,5-diyl)bis (methanylylidene)) bis(2,6-dichloro-4-(trifluoro-methyl) aniline) (4c)

M.F: $C_{27}H_{12}Cl_6F_6N_4O_2$, M.W: 749.89 Yield 86 %, M.P. 197 ºC. C, H, N Elem. Anal. Cal: C, 43.17; H, 1.61; N, 7.46. Obs: C, 43.12; H, 15.12; N, 7.41. **FTIR (KBr) cm^{-1}:** 1679 (C=N stretching), 2942 (C-H stretching of N=C-H), 1410 (CH_2 bending), 1248 cm^{-1} (C-N stretching), 3088 (C-H stretching of CH_2), 1522 (Aromatic C=C stretching, 1 peak), 1345 (NO_2 symmetric stretching), 1496 (NO_2 asymmetric stretching), 739 cm^{-1} (C-Cl stretching), 1136 (C-F stretching), 1005 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d^6 δ ppm):** 8.10 (s, 1H, Ar-H), 7.70 (s, 3H, Ar-H). 7.80 (s, 4H, Ar-H), 7.30, (s, 2H, Ar-N=C-H), 3.20 (s, 2H, CH_2). **^{13}C-NMR (DMSO-d^6 δ ppm):**127-130 (d, 7C, Ar-C), 131-136 (s, 7C, Ar-C) 140-(s, 5C, Ar-C), 125-130 (s, 4C), 135-140 (d, 1C,

Ar-C), 170 (d, 2C, N=C-H), 40 (t, 1C,). **HRMS (ESI):** calculated: 749.89 found: 742.82

2.2.4. N,N'-((2,6-dichloro-1-(2,6-dichloro-4-(trifluoromethyl) phenyl)-1,4- dihydro-pyridine-3,5-diyl) bis (methanylylidene)) bis (2,6-dichloro-4-(trifluoromethyl)aniline) (4d)

M.F: $C_{28}H_{10}Cl_7F_9N_3$, M.W: 843, Yield 84%, M.P. 84°C. **C, H, N Elem. Anal.** Cal: C, 39.89; H, 1.20; N, 4.98. Obs: C, 39.83; H, 1.15; N, 4.91. **FTIR (KBr) cm-^{1}:** 1680 (C=N), 2926 (C-H stretching of N=C-H), 1382 (CH_2 bending), 1299 (C-N stretching), 3088 (CH_2), 1588 (Aromatic C=C stretching, 1 peak), 3000-2950 (N=C-H), 780 (C-Cl), 1092 (C-F stretching), 874 (C=C-H bending). **^{1}H-NMR (500 MHz, DMSO-d6 δ ppm):** 7.85 (s, 6H, Ar-H), 3.25 (s, 2H, CH_2), 7.65 (s, 2H, Ar-N=C-H). **^{13}C-NMR (DMSO-d6 δ ppm):**120-130 (d, 8C, Ar-C), 130-135 (s, 6C, Ar-C) 140-(s, 5C, Ar-C), 125-130 (s, 4C), 125-130 (d, 1C, Ar-C), 158 (d, 2C, N=C-H), 120-125 (S, 1C, F-C), 35-40 (t, 1C,) **HRMS (ESI):** calculated: 843 found: 837.63

2.3. Biological activity evaluation

2.3.1. Antimicrobial activity

All synthetically designed novel compounds (2a-j) and (4a-d) were assayed for their antimicrobial activities *in vitro* against two bacterial strains, Gram positive *Bacillus subtilis*, Gram negative *Escherichia coli* and two fungal strains, *Aspergillus niger* and *Candida albicans* respectively using disc diffusion method.

2.3.2. Antimicrobial Assay

Stock solution (1000 microgram per ml) of each compound was prepared in DMSO solvent. The assay was carried out by disc diffusion method using a concentration 100 microgram per disk. Hi-media antibiotics disc: Chloramphenicol and Amphotericin-B (10 microgram/disc), humidified with aqua are used as standard references to screen antimicrobial properties of synthetic molecules against bacteria and fungi respectively.

Microbial media used for bacteria are nutrient agar (Hi media) with composition (gL-1): Sodium chloride, 5.0; Beef extract 10.0; Peptone 10.0 (pH 7.2). However microbiological media used for fungi and yeast is Potato dextrose agar (all ingredients of Hi media) with composition (gL^1): Potatoes infusion, 200; Dextrose, 20; Agar, 15; Final pH (at 25°C) 5.6±0.2.

Nutrient agar was synthesized under the proper instructions of a high-media producer and it was conserved to cool without any solidification. After a while, it was poured into Petri dishes under non-contaminated condition till it becomes strengthened. 0.1 ml of microbial swab saline suspension was implanted over the agar plates using a microsyringe and such suspension was spread on the entire surface using a curved glass rod under sterile condition.

Paper discs around 6 mm in size with circular shape containing a fixed amount of test sample solution were merged on the facet area of inoculated agar plates using sterile forceps and simultaneously pushed down to assure that discs and agar surface were in touch. In a exact way paper discs saturated with controls (DMSO and reference standard) were placed on agar plates and plates were placed for incubation at optimum growth temperature for 24 hours (for antibacterial properties evaluation) or 3 to 7 days (for antifungal properties evaluation) and finally, results were investigated. It was believed that for compounds that showed antimicrobial activity around the disc, the zone of inhibition was observed. This indicates that microbial growth is inhibited by effective test samples. The diameter of zone of inhibition was measured by Vernier Caliper in mm and tabulated in below mentioned table 1 and 2.

3. RESULT AND DISCUSSION

A series of halovinyl aldehydes (2a-j) and (4a-d) were synthesized using various substituted cyclic succinimides and gluraimides respectively. In continuation of our previous work, we have designed a series of novel Schiff bases from halovinyl aldehydes (1a-j), (3a-d) and 2,6-dichloro-4-(trifluoro methyl)aniline) under the catalytic amount of acetic acid in ethanol/methanol. It has been noted that in case of N-aryl halovinyl aldehydes having electron-withdrawing effects on their phenyl ring, provides a high yield of Schiff bases, while those having an electron-donating, as well as electron-withdrawing effects on the phenyl ring, shows moderate to low yield of Schiff bases. All these newly developed Schiff bases were characterized by elemental analysis and their spectral analysis techniques like FTIR, ^{1}H-NMR,^{13}C-NMR and Mass spectroscopy.

3.1. Biological activity

The novel series of compounds (2a-j and 4a-d) were screened for their antimicrobial activities over two bacterial strains such as gram-positive *"Bacillus subtilis"*, gram-negative "*Escherichia coli*" and fungal strains

Aspergillus niger and *Candida albicans* by disc diffusion method *in vitro*.

A 6 mm cellular Paper discs having an appropriate volume of test sample solution along with paper disc saturated by controls were merged over inoculated solid agar plates. Eventually plates were placed in the incubator at optimum growth temperature for few days and the final results were examined by observing zone of inhibition. Table (1 and 2).

All compounds were tested for their antimicrobial properties over bacteria and fungi. It was found that few of them were more potent, while most of the compounds exhibited fine to moderate activities. Compound 4a was found to be a potent antibacterial agent; however 2a, 2b, 2e, and 2h exhibited good activity against *Bacillus stibillis.* In the same way compound 4a, 4b and 4d showed acceptable effects against *Escherichia coli* and 2d was observed moderately effective against *Bacillus stibillis* while 4e, 4h were observed as mildly effective against *Escherichia coli*.

Similarly these compounds were assayed for their antifungal properties against two fungal strains. It was noted that majority of the compounds were revealed as antifungal agents. It was also recognized that compounds 2a and 4b have significant antifungal properties against *Aspergillus niger* while compound 2d was found as the most effective antifungal agent against *Candida albicans.* Among them most of the compounds were examined as good to mild antifungal agents against both fungal strains.

Table 1: Antibacterial activity of compounds 2a-e and 4a-d

Sr. No.	Sample	*Bacillus stibillis*		*Escherichia coli*	
		Mean	SD	Mean	SD
1	2a	9.15	±0.20	8.38	±0.21
2	2b	9.02	±0.23	10.03	±0.23
3	2c		-		-
4	2d	6.12	±0.21	-	-
5	2e	7.85	±0.13	6.14	±0.19
6	2f	-		-	-
7	2g	-	-	-	-
8	2h	8.96	±0.15	6.27	±0.26
9	2j	-	-	-	-
10	4a	11.23	±0.14	7.96	±0.22
11	4b	-	-	-	-
12	4c	8.3	±0.23	-	-
13	4d	-	-	-	-
	ctrl	-	-	-	-
	Std	18.79	±0.17	18.87	±0.12

Zone diameter in mm (Mean±SD) for 100 microgram per disk

Table 2: Antifungal Activity of compounds 2a-e and 4a-d

Sr. No.	Sample	*Aspergillus Niger*		*Candida Albicans*	
		Mean	SD	Mean	SD
1	2a	8.66	±0.13	.87	±0.16
2	2b	12.07	±0.18	9.56	±0.19
3	2c		-	6.24	±0.10
4	2d	8.21	±0.23	13.05	±0.13
5	2e	9.33	±0.28	10.12	±0.18
6	2f	8.85	±0.11	6.36	±0.16
7	2g	6.45	±0.15	8.10	±0.23
8	2h	8.68	±0.17	7.74	±0.26
9	2j	-	-	-	-
10	4a	13.56	±0.18	6.32	±0.31
11	4b	7.02	±0.25	7.20	±0.16
12	4c	6.32	±0.27	7.14	±0.11
13	4d	-	-	7.98	±0.15
	Cntrl	-	-	-	-
	Std	19.35	±0.21	19.40	±0.18

Zone diameter in mm (Mean±SD) for 100 microgram per disk

Fig. 1: Antibacterial activity of compounds 2a-j and 4a-d (1 to 13) against *Bacillus stibillis*

Fig. 2: Antibacterial activity of compounds 2a-j and 4a-d (1 to 13) against *Escherichia coli*

Fig. 3: Antifungal activity of compound 2a-j and 4a-d (1 to 13) against *Aspergillus Niger*

Fig. 4: Antifungal activity of compound 2a-j and 4a-d (1 to 13) against *Candida albicans*

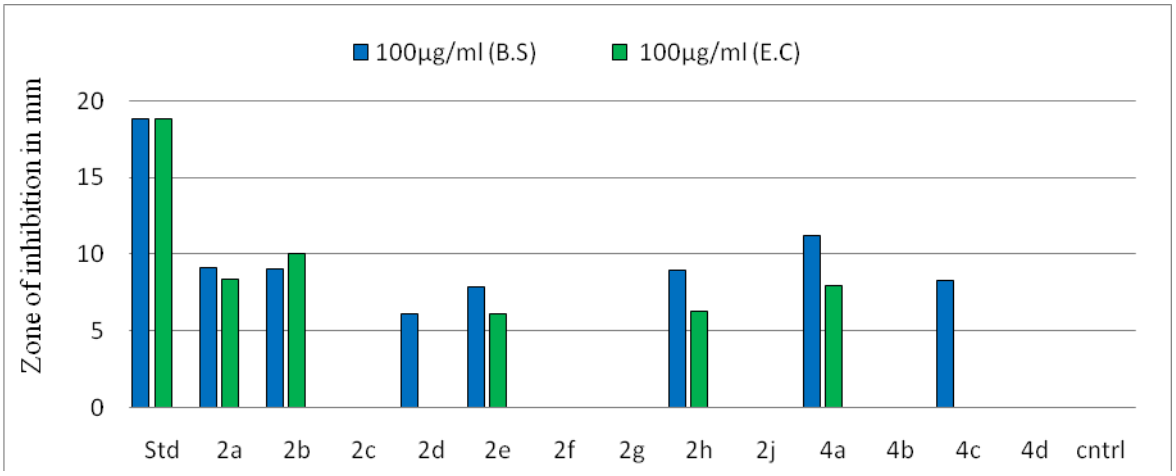


Chart1: Antibacterial activity of compounds (2a-j) and (4a-d)

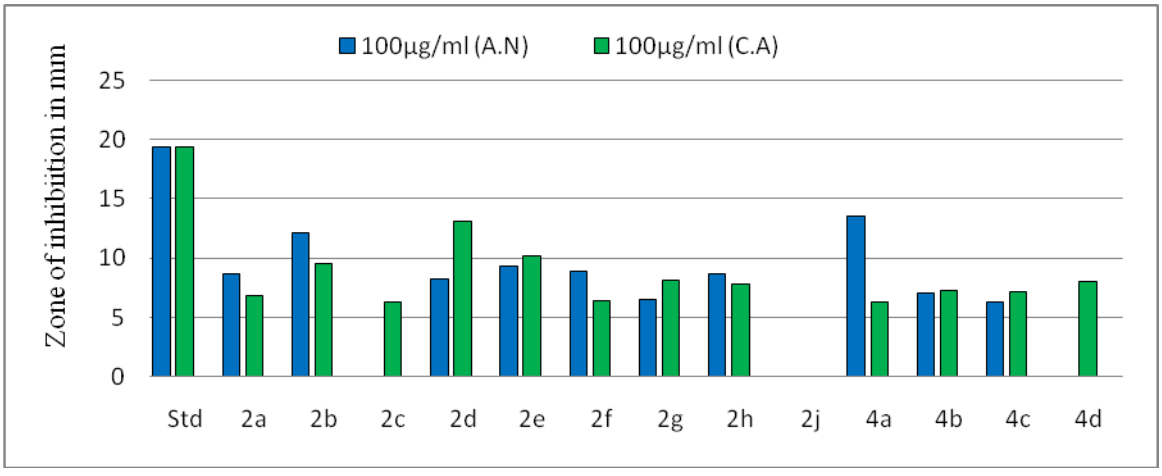


Chart 2: Antifungal activity of compound (2a-j) and (4a-d)

4. CONCLUSION

Two novel series of Schiff bases derived from several substituted halovinyl aldehyde (1a-j), (3a-d) and 2,6-dichloro-4-(trifluoromethyl)aniline) have been described by well established facile route using an eco-friendly method, all synthetically developed compounds were characterized by several spectral analysis techniques and evaluated for their antimicrobial properties. It is

concluded that among these compounds (2a-e) and (4a-d) few were exhibited good to moderate antibacterial activity while most of the compounds were observed as antifungal agents. Besides compound 4a was found potent antibacterial compound however compound 4b, 2a, and 2d were found significantly effective over fungal strain.

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