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*Original article*

# Antibacterial, Antidiabetic, Antioxidant and DNA cleavage studies of novel N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxypropyl) benzene sulphonamide ligand

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## Abstract

The novel N (3-(bis(pyridine-2ylmethyl)amino)-2-hydroxypropyl) benzene sulphonamide ligand have been synthesized from 1,3-Diamino-propan-2-ol. The structure of the ligand was confirmed by Mass spectroscopy and $^{1}$H NMR spectroscopy. The synthesized Schiff base ligand was tested for their in vitro anti bacterial action with Gram-positive and negative bacteria. The anti-diabetic activities have been tested with α-amylase inhibition method and antioxidant effect of the compound was established using DPPH method. Thus all the studies reveals that the synthesised Schiff base compound has significant antibacterial, antidiabetic and antioxidant activities. The DNA cleavage studies shown that, the DNA binding nature of the ligand was appreciably good. The Molecular docking characteristics were supported that the binding approach of the effective inhibitors with the active site of enzymes.

**Keywords** sulphonamide, antibacterial, antidiabetic, antioxidant, DNA cleavage and stability.

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# Introduction

As the last decade, researchers focusing on the synthesis of Schiff base, has risen extensively due to their beneficial applications in significant fields. The Schiff base are synthesized by condensation reaction by using the substituted aldehydes or ketones with aliphatic and aromatic amines that produced mostly in presence either acid or base catalysis or necessary heat[1]. The Schiff bases were initially reported by German chemist Nobel Laureate Hugo Schiff in 1864. Later a variety of Schiff bases were reported by different researchers [2-4]. The Schiff base ligands encompasses with the several donor atoms like nitrogen, Sulphur and oxygen [5]. Amongst the Schiff bases, 2-pyridyl aldehyde derived imines are exhibits large number of biological activities either alone or with metal complexes [6]. These legends with metal complexes were employed in drugs and possess appreciable biological activities like antibacterial [7], antifungal [8], antiviral[9], anti-inflammatory[10] and antitumor activities[11], antifertility[12], antioxidant[13], herbicidal[14] and antiproliferative [15]. Schiff base ligands have enticed countless attention owing to their potential applications in DNA recognition. This also have the good fluorescence [16], aggregation[17]a potentiometric cation caring[18], anthelmintic[19] and photoluminescence[19] properties. The numerous applications of Schiff base in dye, pharmaceutical, food, analytical, catalysis, fungicidal, agroindustry and biological field were reported by the various researchers [21].

In this article we have selected 1,3-diamino-propan-2-ol based Schiff base was prepared due the nature and excellent biological activity from the literature[32]. The sulphonamide and amide functional groups present in the schiff base is similarly contain the many of the drug molecules, aggregation[17] a potentiometric cation caring[18], and anthelmintic[19] and photoluminescence[20] properties.

# Materials and methods

## Apparatus and chemicals

The chemicals, such as raw materials and solvents with highest purity were purchased from Sigma Aldrich products and were used without any purification. The Mel-Tem (Mitamura Riken Kogyo) melting point apparatus was used to find out the melting points of the product. The FTIR-8300 Shimadzu Spectrophotometer with KBr pellet was employed for the determination of infrared(FTIR)spectrum of the product in the frequency range of 4000–200 $cm^{-1}$.The UV– Visible spectra were chronicledwithTCC-240- A instrument, using chloroform as solvent for 200– 1100 nm range. A Bruker 400 MHz spectrometer with DMSO-d6 as solvent was used to determine $^{1}H$ and $^{13}C$NMR spectra. Mass spectra of the samples were recorded with Micromass UK PLATFORM II LC-MS spectrometer.

## Experimental procedure

***Preparation of N(3-(bis(pyridine-2ylmethyl) amino)-2-hydroxypropyl)benzenesulfonamide (Ligand-1):***

***Step-1: Synthesis of (3-Amino-2-hydroxy-propyl)-carbamic acid tert-butyl ester (3):***

1,3-Diamino-propan-2-ol (**1**) (10 g, 0.11 moles 1 eq) and dry DCM (150 mL) was taken in 250 ml 3 neck RB flask with constant stirring. Under $N_2$ atm, $Et_3N$ was added to it and then cooled for 0°C. To the reaction mixture BOC anhydride (24.2 g, 0.11 moles, 1 eq) was added slowly in the temperature range from 0 to 5 °C for 30 min. After the adding all reagents the reaction mixture was allowed for uniform stirring in RT for 2 h. Then DCM (250 mL) was used for dilution and water (125 mL) was used to washing of the contents. The layer of DCM was separated and dried with sodium sulphate. Then it was concentrated in reduced pressure condition the crude product was obtained. The obtained product was ground to a fine powder with diethyl ether. The white solid mass was filtered and dried to get the (3-Amino-2-hydroxy-propyl)- carbamic acid tert-butyl ester (**3**) as a white solid mass (15 g, Yield=71%). LCMS: $(M+H)^{+}$: 191.3; 1H NMR (400 MHz, DMSO-$d_6$): δ 6.68 (t, J = 5.6 Hz, 1H), 3.35 (m, 1H), 2.96 (m, 2H), 2.51 (m, 1H), 2.39 (m, 1H), 1.32 (s, 9H) ppm.

***Step-2: Synthesis of (3-Benzenesulfonylamino-2-hydroxy-propyl)-carbamic acid tert-butyl ester (5):***

(3-Amino-2-hydroxy-propyl)-carbamic acid tert-butyl ester (1 g, 0.005 moles, 1 eq) and dry DCM (15 mL) was taken in 100 mL 3 neck RB flask with uniform stirring of the solution. Under $N_2$ atm $Et_3N$ (0.9 mL, 0.006 moles, 1.2 eq) was added and cooled to 0 °C. Benzene sulphonyl chloride (**4**) (0.95 g, 0.005 moles, 1 eq) was added slowly to maintaining the temperature below 0 °C. All the reagents were added in the reaction mixture then it was kept with constant stirring at RT about 3 h. DCM (75 mL) was used to diluting the contents and then washed with water (25 mL). The separated DCM layer was dried with sodium sulphate. Under reduced pressure the product was concentrated then the crude product was obtained. The product was ground with diethyl ether, a white product (solid) was obtained. It was filtered and dried to get the (3-Benzene sulfonylamino-2-hydroxy-propyl)-carbamic acid tert-butyl ester (**5**) as a white colored solid product (1.4 g, Yield=82%). LCMS: (M+H)+: 331.5; $^{1}H$ NMR (400 MHz, DMSO-$d_6$): δ 7.83 (d, J = 8 Hz, 2H), 7.62 (m, 3H), 5.62 (broad s, 2H), 3.76 (m, 1H), 2.93 (m, 1H), 2.76 (m, 2H), 2.63 (m, 1H) ppm.

***Step-3: Synthesis of N- (3- Amino-2-hydroxy-propyl)-benzene sulfonamide( 6):***

(3-Benzenesulfonylamino-2-hydroxy-propyl)-carbamic acid tert- butyl ester (1 g, 0.0030 moles, 1 eq) and dry DCM was taken in 50 mL single neck RB flask with a constant stirred solution. Under $N_2$ atm 4N HCl in dioxane (3.5 mL, 0.0121 moles, 4 eq) was added at 0 °C. Subsequently the addition was completed then it was kept with constant stirring at RT for 2 h. Under reduced pressure the reaction mixture was concentrated to get the crude product. The obtained product was dried to get the N-(3-Amino-2-hydroxy-propyl)-benzene sulfonamide hydrochloride salt (**6**) as a white colored solid (0.6 g, Yield=87), it was taken for subsequent step without purification. LCMS: $(M+H)^{+:}$ 231.4; $^1$H NMR (400 MHz, DMSO-d$_6$): δ 7.90, (broad s, 4H), 7.83 (d, J = 8 Hz, 2H), 7.62 (m, 3H), 5.62 (broad s, 1H), 3.76 (m, 1H), 2.93 (m, 1H), 2.76 (m, 2H), 2.63 (m, 1H) ppm.

***Step-4: Synthesis of N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxypropyl) benzene sulfonamide (Ligand-1):***

N-(3-Amino-2-hydroxy-propyl)-benzene sulfonamide hydrochloride salt (**6**) (0.25 g, 0.0011 moles, 1 eq) in absolute ethanol (10 mL) was taken in 50 mL single neck RB flask with a uniform stirred solution. Under $N_2$ atm, Pyridine-2-carbaldehyde (0.48 g, 0.0023 moles, 2.1eq) was added. The entire mixture was heated about 80 °C and agitated for 2 h. Then the mixture was cooled to room temperature. The reaction mixture was stirred for 1h at RT after the addition of $NaBH_4$ (0.167 g, 0.0022 mmol, 2 eq). The reaction mixture was concentrated under reduced pressure and the obtained crude product was diluted with EtOAc and water. The EtOAc layer was separated, washed with brine water solution and dried over sodium sulphate. The product obtained was purified by silica column purification to get the N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxypropyl) benzene sulfonamide (0.35 g, Yield=75%). LCMS: (M+H)+: 413.0; 1H NMR (400 MHz, DMSO-d$_6$): δ 8.50, (d, 2H), 7.96 (t, 1H), 7.78-7.97 (m, 2H), 7.77-7.7.70 (m, 3H), 7.69-7.63 (m, 3H), 7.62-7.557 (m, 2H), 7.34-7.7.33 (d, J=7.6 Hz, 2H), 7.26-7.23 (m, 2H), 4.99 (m, 1H), 4.11 (m, 1H), 3.73 (s, 4 H), 3.19 (m, 2H), 2.88-2.82 (m, 2H), 2.68-2.63 (m, 1H), 2.62-2.57 (m, 1H) ppm.

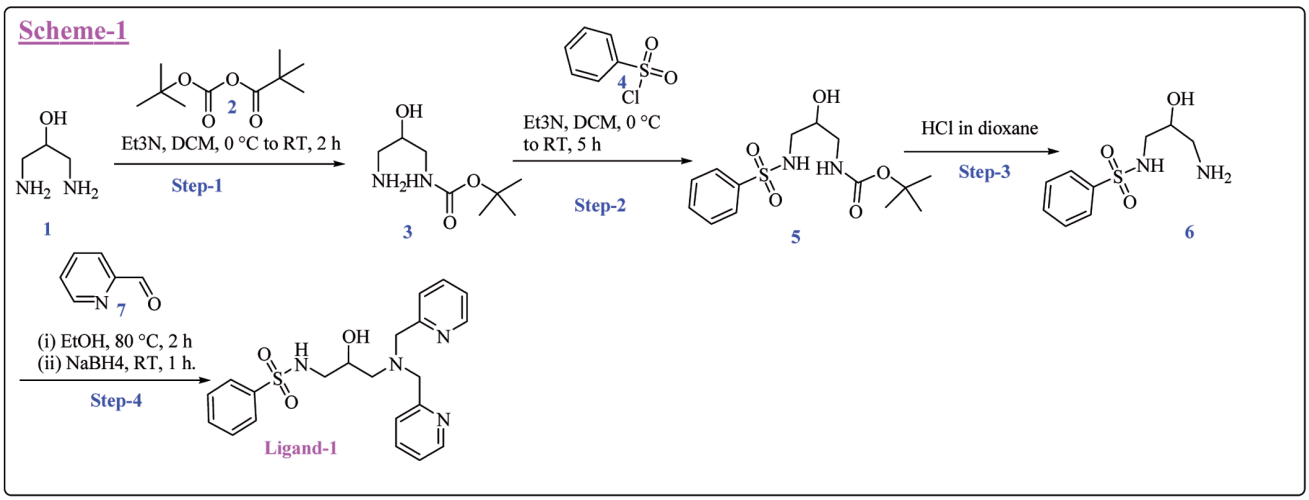
## Biological studies:

***Antioxidant activity (Total antioxidant activity):***

The Reactive oxygen species (ROS) are produced as a natural by products of oxidative cellular metabolism reactions in our body system the produced ROS are significantly play important roles in the modulation of cell existence and other cell activities. The ROS radical such as hydroxyl radical, superoxide anion, and $H_2O_2$ are more active and effectively destruct the chemical groups. The ROS effect on lipids, proteins, and nucleic acids may create a variety of chronicle damages, like coronary heart disease, atherosclerosis and cancer[44]. Therefore, it is essential to avoid the free radical action in our body, we can use immunise drugs which possess rich in antioxidants. The inhibitors along with antioxidant performance have been a supreme therapeutic prospective, in view of the fact that oxidative damage and swelling are shows a basic mechanism to asses a numeral of human health disorders, including diabetes[34-37].

***Determination of Total antioxidant activity:***

The total antioxidant ability of ligands was measured by using the following procedure. To the analytical samples with different concentrations 3ml of antioxidant reagent - (28 mM $Na_3PO_4$, 0.6 M $H_2SO_4$ and 4 mM ammonium molybdate) was added. Then the analytical sample was achieved appropriate diffusion with phosphomolybdenum reagent when it was incubated for 95°C and a period of 90 min in a water bath. The total antioxidant ability of samples and vitamin C standard of drug were determined using spectrophotometer[38] in the absorbance range of 695 nm. Schiff base was appreciably shown the antioxidant action owing the presence of various




Scheme 1. Synthesis of N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxypropyl)benzenesulfonamide.

functional groups like, hydroxy, phenoxy, and amino groups in its structure[38] , therefore the following formula was used to calculate the total antioxidant activities.

$$TOA = [(A_t - A_c)/A_t]X100.$$

### Antidiabetic activity (α-amylase inhibitory method)

***Experimental section; α-Amylase- inhibition technique:***

The α-amylase inhibition technique was employed to determine the anti-diabetic activity of the ligand. In this technique the standard solution and 0.5 mg/ml of amylase was incubated for 10 min with extract and without extract about 25◦C in 20 mM sodium phosphate buffer solution (pH 6.9)[42]. Then 1mL of starch solution (1%) was added and the contents were incubated for another 30 min at 25◦C. The DNSA reagent (1mL) was added as the color reagent to bring to a close the enzymatic reaction, and then it was incubated in a hot water bath for 15min. After attaining to room temperature, the spectrophotometer instrument[32-33]was employed to determine the absorbance in the range of 540 nm. The experimental absorbance value was compared with Absorbance control. The % of inhibition was calculated using the following formula.

% α -Amylase inhibition = Absorbance of control –Absorbance of complex X100

### Absorbance of control

***Stability study:***

1 mM concentration of the ligand was dissolved in phosphate buffer (pH =7.4, 5mL) ( PPA). From that, 200 µL of the sample was diluted in 2 mL of phosphate buffer. The diluted sample was incubated at 37 ˚C for 10 min[28]. The absorbance study was carried out in the range of 270 nm for the degradation and the experiment was repeated nearly 24 hours with different time intervals at 37 $^0$C. The PPA stability was calculated from the diminishing values of the absorbance[29].

### Antibacterial activity Results:

***Antibacterial activity:***

In vitro antibacterial screening of the Schiff base and its metal complexes (Table 1) were examined against Gram-positive bacteria, namely, Enterococcus faecalis and Staphylococcus aureus and Gram-negative bacteria, namely, Escherichia coli, and Pseudomonas aeruginosa using disc diffusion method[24-25].

***Disc-diffusion method:***

It is very important aim to preparation of antimicrobial substance which inhibiting the basic microbe exclusive of any side effects to the patients. The significance of the distinctive character of the Schiff base, it can be proficient to apply securely in the treatment of diseases. It is observed that the increasing concentration of test solution significantly increase biological activity. The lowest inhibitory concentration (LIC) values of the substance were shown in the Table 1.The experimentally found LIC values specify that the compound having superior antimicrobial activity.

The disc diffusion method was adopted for the determination of antibacterial activity of prepared sample. The target bacteria was grown-up in Nutrient broth and incubated for 24 hrs. The diluted bacterial strain was cultured using Petri dishes containing Nutrient agar (NA) medium. The primed discs were kept on the culture medium. To the sterile disc[26] examination samples (500µg, 1000µg and 2000 µg) were introduced. Streptomycin (Std drug) (20µg) was employed as a affirmative reference standard. Then the immunized plates were incubated about 37 °C for 24 h. The clear zone around the disc diameter was determined and given in mm since its antibacterial activity[27-30].The activity of compound RV2 showed excellent activity against all organisms.

*DNA Cleavage Assay*

It is a reaction that ruptures any one of the covalent bond in a sugar-phosphate linkages among nucleotides in the sugar phosphate of DNA. It is catalysed by employing either enzyme or chemical or by radiation. Cleavage or rupturing whether exo-nucleolytic it might be removes the end nucleotide, or endo-nucleolytic then it splits the strand into two[12].

The various Studies relating to DNA cleavage by artificial reagents are of substantial attention due to their efficacy as biological tools in all organisms. The super coiled pBR322 DNA endorsed by metal complex was ensued by adding of substance (20µl). The 20µl of the mixture have pBR322 DNA, 10mM $H_2O_2$, 50mm NaCl and 50 mM Tris–HCl then followed by the addition Millipore water. All the contents were incubated at 37º C for 1 hr. Agarose electrophoresis method[42] was employed for the analysis.

## Results and discussion

### Synthesis

It is reported that the synthesis of novel N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxy propyl) benzene sulfonamide (Ligand-1) as shown in **Scheme 1.** The synthesis started with 1,3-diamino propane-2-ol treated with Boc anhydride in the presence of triethylamine base in dichloromethane solvent at room temperature conditions to get compound 3 as mono Boc-protected compound with excellent yield and purity. It was treated with triethylamine base along with dichloromethane solvent and benzoyl chloride to get compound 5 with good yield. Then compound 5 treated with HCl in

dioxane gave deprotected amine hydrochloride compound 6. It was then reductive aminated with Pyrdine-2-carboxaldhydeunder NaBH4 reducing agent gave N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxy propyl) benzene sulfonamide with considerable amount of yield.

## Characterization

The Intermediates and N(3-(bis(pyridine-2ylmethyl) amino)-2-hydroxypropyl) benzene sulfonamide (ligand-1) were checked by NMR spectroscopy. The ligand was furthermore analysed by LCMS spectral investigations. The observed results were compared with literature.

## $^1$H NMR spectral analysis of HL1ligand

The $^1$H NMR spectra of the Ligand-1 examined, it was found that the symmetric pyridine protons were appeared as 2 set of protons. Down field doublet of 2 protons with 6.0 Hz at δ 8.50 represent the protons of the C2-pyridine rings. A broad proton at δ 4.99 represents the proton from OH group. A triplet with 6.0 Hz at δ 7.96 of 1 proton represents the presence of sulfonamide NH proton. The pyridine attached N-CH2 protons are appeared at δ 3.70 with 4 protons. In the aromatic side, 14 protons (including sulfonamide proton) were appeared. In the aliphatic side, 10 protons (Including hydroxyl proton) were appeared .$^1$H NMR signal denoted 21 protons, and furthermore it shown 7 sets of proton signals. The spectrum of the ligand was verified on comparison with intermediate-6. The NMR spectra and the corresponding interpretations were shown in Fig-1 and Fig-2.

## LC-MS spectra of the ligand HL1

The LC-MS spectrum of the hydro chloride salted ligand was confirmed and displayed in the molecular ion peak at m/z value at 413.0 shown in Fig.3.

## Biological studies

### *In vitro antioxidant activity (DPPH scavenging assay)*

The antioxidant activity of the Ligand-1 was determined by DPPH free radical scavenging method. To check the activities Vitamin - C was used as a reference material. Different concentrations (10-500 mM) were used to check the antioxidant activity of the Ligand-1 and reference material. The Ligand-1 and reference results are shown in Fig.4. It was observed that t 10-500 mM concentrations Ligand-1 showed equal activity to the standard in DPPH free radical scavenging studies. The N-(3-Amino-2-hydroxy-propyl)-benzamide hydrochloride containing NH possibly will act as hydrogen donor to slake with the DPPH in addition it produce an aryl radical could stabilize in the pyridine azonylphynyl conjugated system. These inference imply that Ligand-1 have awfully antioxidant activity.

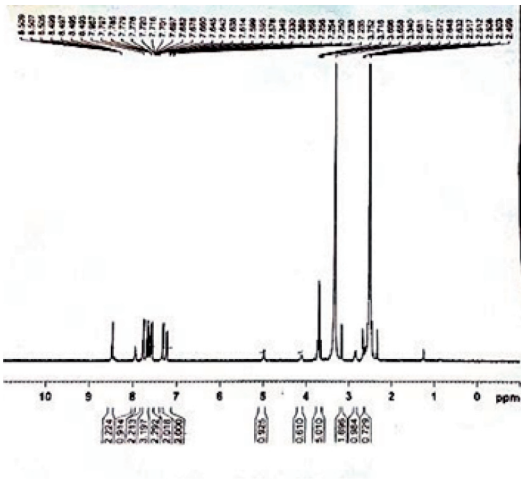



Fig. 1. $^1$H NMR full spectra

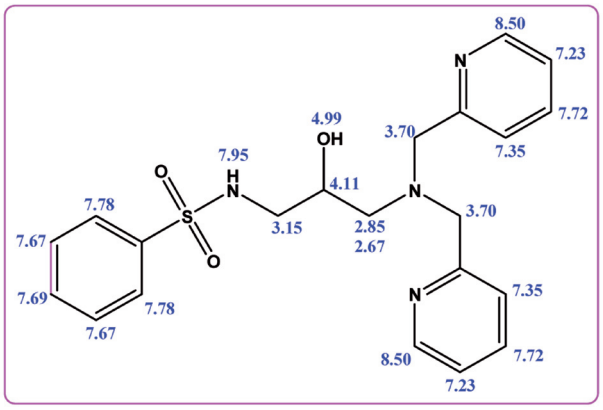



Fig. 2. $^1$H NMR chemical shifts values of Ligand-1.

Table 1 Antioxident properties of DPPH scavenging assay (STD: Vitamin - C)

| S.No | Ligand-1 Concentration (µg/mL) | Inhibition % | STD |
|---|---|---|---|
| 1 | 10 | 4.42 | 25.25 |
| 2 | 50 | 13.38 | 42.44 |
| 3 | 100 | 18.21 | 65.9 |
| 4 | 250 | 23.85 | 82.97 |
| 5 | 500 | 31.86 | 95.72 |

### *Antidiabetic activity*

The α-amylase enzyme inhibition method was employed for the determination of antidiabetic activity of Ligand-1. Here the standard drug was used as Acarbose which is advised to control the blood glucose level[43]. Various concentrations of acarbose and Ligand-1 of VK-1 (10, 25, 50, 100 and 500 mM) was treated to the inhibition activity of the α -amylase enzyme under suitable condition. The inhibition activity of Ligand-1 was significant value and its values were close proximity with the standard acarbose. A variety of concentrations and inhibition activity percentage were presented in Fig. 5.

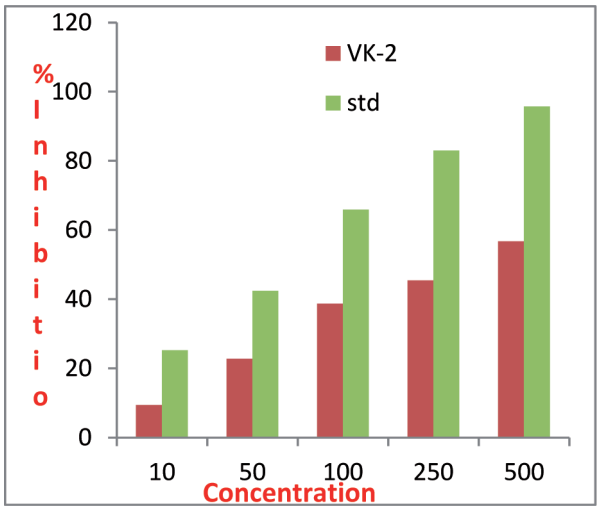



Fig. 4 Antioxidant activity of Ligand-1 (VK2) ligand: DPPH Free radical scavenging activity Standard: Vitamin C

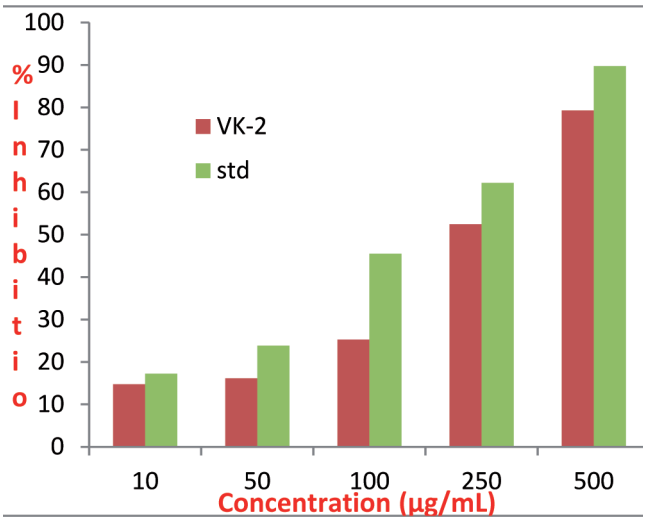



Fig. 5. Antidiabetic activity: α -amylase inhibitory activity ofLigand-1 (VK2). Standard: Acarbose

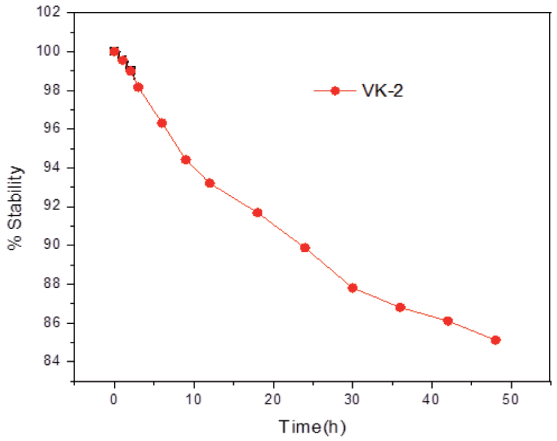



Fig. 6. Stability of Ligand-1 (VK2) ligand

***Stability study***

The bioavailability was limited by the poor stability so it is essential to determine the stability study by performing with reported method[44].

The variation in absorption of Ligand-1 was calculated in the presence of Tris-HCl buffer solution to maintain the pH 7.4 at 37 °C. UV-Vis spectrometer was employed with various interval of time (0, 4, 6, 8, 16, 20 and 24 h) used for the degradation effect of Ligand-1. From the observation of the experiment, within 24 h in a buffer solution 7.88% of ligand was degraded and 92.12% of the Ligand-1 compound was more stable under the experimental condition. It suggests that the Ligand possess excellent stability and it was presented in Fig. 6.

***Antibacterial activity:***

In vitro antibacterial inhibition efficiencies of the Ligand-1 (Table 3) were tested with Gram-positive bacteria, namely, Enterococcus faecalis and negative bacterium, the Ligand-1 exhibited significant effectiveness for gram negative (P. aeruginosa bacterium) than that of the other three gram negative and positive bacterium. Therefore the consequence of Ligand-1 counter ions comprises comparatively superior inhibition activity than the other ligands.

Table .2. Antidiabetic properties of DPPH scavenging assay (STD: Vitamin - C)

| S.No | Ligand-1 Concentrations (VK-1) (µg/mL) | Inhibition % | STD |
|---|---|---|---|
| 1 | 10 | 15.2 | 17.22 |
| 2 | 50 | 18.7 | 23.84 |
| 3 | 100 | 27.61 | 45.51 |
| 4 | 250 | 59.22 | 62.19 |
| 5 | 500 | 82.35 | 89.71 |

***Antibacterial activity outcome*:**

The Gram-positive like *Enterococcus faecalis*, *Staphylococcus aureus* and Gram-negative bacteria like *Escherichia coli*, *Pseudomonas aeruginosa* were used for the determination of inhibition efficiencies of the Schiff's base ligands.

The solvent DMSO does not show any zone of inhibition and does not interferes with the results so it was reserved as control in all plates in the antimicrobial activity for microorganisms. The investigational result was revealed in Table 3 which specify that Ligand-1 ligand having higher inhibition efficiency is due to chelate formation mechanism. During the investigation of antimicrobial activity of Ligand-1 The following factors [18] were contemplated. They are (i) the chelating effect of ligands; (ii) the nature of the N-donar ligands; (iii) charge of the complex; (iv) existence of ion with counterbalance potential of the ionic complex and (v) the nuclearity of the central metal ion in the complex. The chelation effect may decrease the polarization of ligand owing to the overlapping of the ligand orbital with inequitable contribution of the positive charge of the central metal ion. In addition that

the delocalization of p-electrons over the entire chelate ring and develops the lipophilicity of the entire complexes. This enhanced lipophilicity develops the carrying of the ligand and complexes into lipid membrane. With the comparison of gram positive and *Staphylococcus aureus* and Gram-negative bacteria, namely, *Escherichia coli* and *Pseudomonas aeruginosa* using disc diffusion method[45-46].

***DNA Cleavage Assay***

The cleavage effectiveness determination was done by the capability of the Ligand-1 to modified as super coiled DNA (Form-I) and it can open a spherical form or purloined form (Form-II). As it was shown in Fig. 7 indicates a significant quantity of increased intensity of bands in exposed circular form in the occasion of the ligand [47]. The various DNA cleavage efficacy was observed in the Ligand-1 mainly owes the dissimilar binding attraction of the HL1 to DNA.

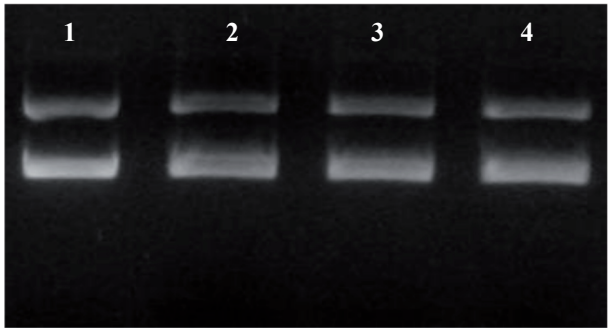



Fig .7. DNA cleavage Activity of the ligand HL1 (RV-2): L 1 –PUC 18 DNA – Control; L 2 –DNA + H2O2 (1mM); L 3 – DNA + $H_2O_2$ (1mM) + RV-2 (1µL); L 4 – DNA + $H_2O_2$ (1mM) + RV-2 (2µL)

## DNA cleavage Activity:

***Molecular docking study with α - amylase***

It is a very important tool for design of drug delivery system in human or animal biology[31].

The objective of molecular docking is to forecast the various mode of binding interactions like Hydrogen bonding, hydrophobic and electrostatic energies of the ligand into bio molecules for more familiar 3D structure[31]. The 3D structure of the enzymes were collected from the protein data bank[21,22]. Auto dock tool (version 4.2) was used for the α-amylase enzyme. The benzamide ligand **HL1** revealed optimum binding energies with 1 HNY exhibited binary hydrogen bonding interactions with different amino acid residues such as HIS101(2.83Å) and ASP300 (2.64Å) respectively in HL1R ligand. The pyridyl CH with hydroxyl oxygen of HIS101 has the conventional hydrogen bonding interactions and their bond distance is acknowledged as 2.83Å Å.

The hydrogen bonding interaction between amide NH with Sulphonamide groupASP300 has the bond distance is found to be 2.64Å their inhibition constant is found to be 4.18 µM. Moreover, the molecular docking interaction of acarbose was done in contradiction of 1HNY.

The HL1S exhibited poor inhibition constant and binding energy than HL1R ligand.

The quantity of hydrogen bond attraction was found to be less than HL1 ligand. The docking outcomes such as inhibition constant, hydrogen bond interactions and binding energy, are summarized in Table. 4 and also the interaction between HL1 and acarbose with 1HNY is presented in Fig.8 & Fig.9.

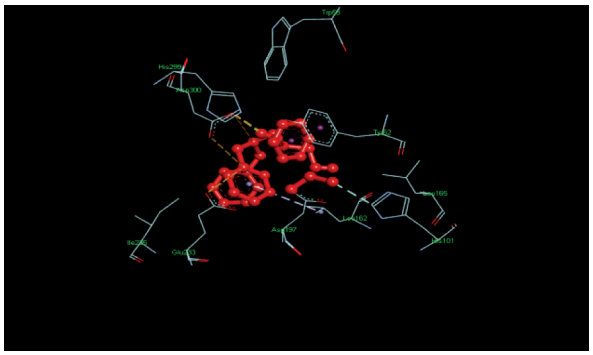


Fig.8.Interaction of HL1R in the active site pocket of 1HNY.pdb

Table 3. Ligands and its complexes antibacterial activity studies

| Sample | Zone of Inhibition (mm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *E. faecalis* | | | *S. aureus* | | | *E. coli* | | | *P. aeruginosa* | | |
| | 500 µg | 1000 µg | 2000 µg | 500 µg | 1000 µg | 2000 µg | 500 µg | 1000 µg | 2000 µg | 500 µg | 1000 µg | 2000 µg |
| **RV2** | - | - | 9 | - | - | 8 | - | - | - | - | - | 9 |
| **STD** | 24 | | | 23 | | | 24 | | | 24 | | |

STD:Streptomycin (20 µg)

Table 4. Docking results of synthesized compounds in the active site pocket of 1HNY.pdb.

| Sample code | Binding energy kcal/mol | Inhibition constant | No of hydrogen bonding | Hydrogen bonding amino acid residue |
|---|---|---|---|---|
| **L1** | -7.34 kcal/mol | 4.18 µM | 2 | HIS101(2.83Å) carbon hydrogen bonding interaction ASP300 (2.64Å) Conventional hydrogen bonding interaction |
| **L2** | -8.24 kcal/mol | 913.11 nM | - | - |

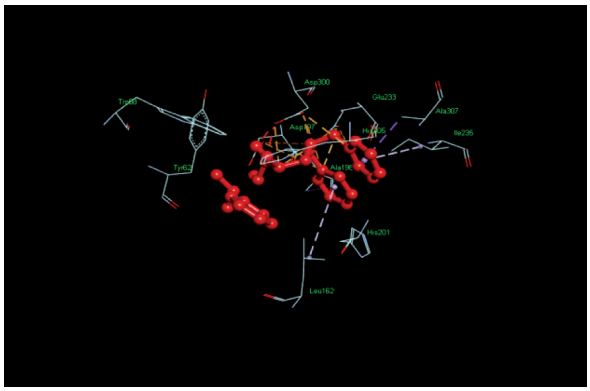


Fig.9 Interaction of HL1S in the active site pocket of 1HNY. pdb

## Conclusion

In the present work we successfully synthesized novel N(3-(bis(pyridine-2ylmethyl)amino)-2-hydroxypropyl) benzene sulfonamide ligand. The ligand have been characterized well with spectral techniques. The result of DNA cleavage study reveals that significant activity. In addition to the result of antibacterial activity exhibited very good activity against S.aureus and E. faecalis are the gram positive and Pseudomonas aeruginosa are the gram negative bacteria. Further it has very high potential application in pharmaceuticals and in medicinal chemistry. Its synthetic compound's antioxidant action and α-Amylase inhibition efficiency are feasibly extraordinary profits to govern the complication of diabetic patients. In vitro stability of the synthesized compounds has also been significant improvement.

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