Research Article

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Synthesis and Characterization of Schiff Base Cu Salpn Complexes and Biological Potential Study

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ABSTRACT

Schiff bases are versatile ligands synthesized from the condensation of an amino compound with carbonyl compounds. In this work, the biological activity of the transition metal complexes derived from the Schiff base ligands has been widely studied. Salpn is the common name for a chelating ligand, properly termed as N, N'-bis (salicylaldehyde) -1, 2-propane diamine. The complexes of copper with Schiff bases have wide applications in food industry, dye industry, analytical chemistry, catalysis, fungicidal, agrochemical, anti-inflammable, anti-radical and biological activities. A new Cu-salpn complex has been synthesized from the reaction of salpn with copper sulphate pentahydrate ($CuSO_4.5H_2O$). The synthesized complex was characterized by IR and UV spectral techniques. Antimicrobial activity has been tested against the bacteria, *viz*, *Antinomyces israelii*, *Corynebacterium diphtheria* and *Staphylococcus aureus* by using Agar well diffusion method.

Keywords: Antibacterial activity; Agar well diffusion method; Salpn.

1. INTRODUCTION

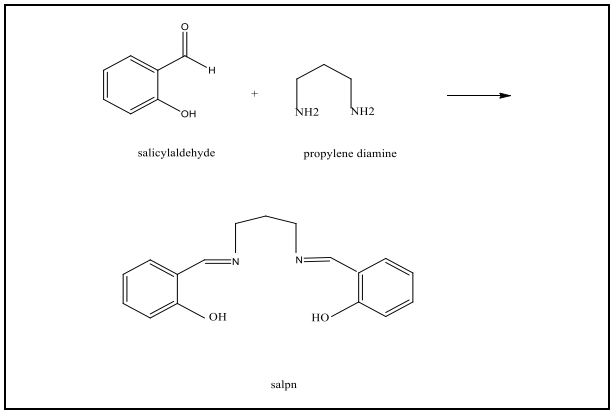
Schiff bases are widely used as analytical reagents since they allow simple and inexpensive preparation of a number of organic and inorganic compounds. Schiff base compounds are very important in medicinal and pharmaceutical fields because of their wide spectrum of biological activities. Most of them show biological activities such as antibacterial, antifungal, as well as antitumor activities (Nair *et al*. 2006; Navan *et al*. 2011).

Antibiotics are most important weapons in fighting bacterial infections and have greatly benefited the health-related quality of human life, since their introduction. However, over the past few decades, these health benefits are under threat as many commonly used antibiotics have become less and less effective against certain illnesses, not only because many of them produce toxic reactions but also due to the emergence of drug-resistant bacteria. It is essential to investigate newer drugs with lesser resistance. Salpn forms stable chelate complexes with many metals, including copper, iron and nickel. It is in coordination with copper that makes it a popular choice as a fuel additive. Copper has the highest catalytic activity in fuel and Salpn forms a highly stable square-planar complex with metal (Salehia *et al*. 2013; Rishu *et al*. 2013).

2. MATERIALS AND METHODS

2.1. Synthesis of Salpn

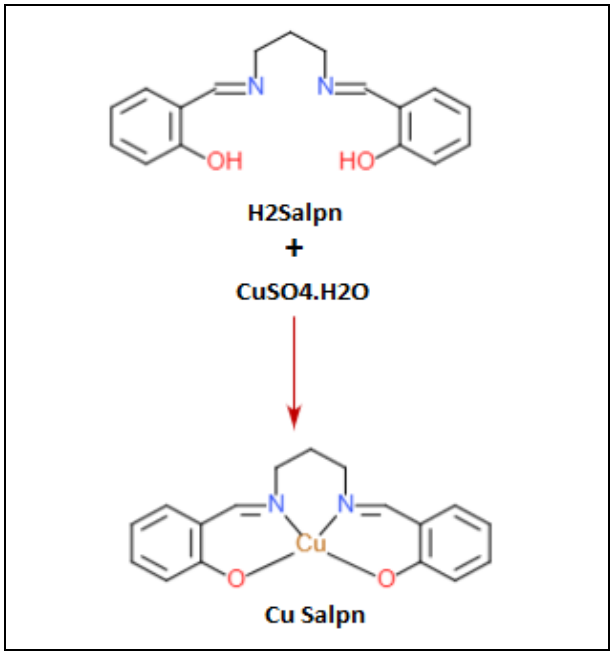
1, 3-propane diamine (2.083 g) was dissolved in 30 ml of methanol and was added dropwise to a stirred solution of salicylaldehyde (6.1g, 0.05 mol) in methanol (30 ml) at room temperature. The reaction flask was equipped with a calcium chloride guard tube to prevent ingress of moisture. After stirring for 30 minutes, the reaction mixture was filtered, the filtrate was collected and the solvent was removed; the crude product was washed with water (60 ml) and dried under vacuum. Recrystallization from petroleum ether afforded salpn as a yellow solid.



Scheme 1: (Yield: 3 g, Melting point: 98-99 ˚C)

2.2. Synthesis of Cu-salpn

3 ml of H_2salpn in 10 ml of methanol was added to a solution of 2.528 g of copper sulphate pentahydrate in 10 ml of methanol with constant stirring. The mixture was refluxed for 1 hour at room temperature. The precipitate was filtered, washed with methanol and dried in air.



Scheme 2: (Yield: 75%, Color: Dark green)

3. RESULTS AND DISCUSSION

3.1 FT-IR Analysis

The Cu-salpn has been characterized by FT-IR to find the functional groups. Fig.1. shows the broad band 3424.8 cm^{-1}, indicating the amine for bending stretching. C-N stretching band, Cu-N bending band, weak C-H band and C=C stretching band were present in the Cu-salpn complex at 1143.47, 455.20, 3064.5 and 1535.34 cm^{-1}, respectively. The corresponding C=N stretching band was observed at 1627.92 cm^{-1}. The peak at 756.10 cm^{-1}, was due to the aromatic ring substitution band (bending mode).

3.2 UV Analysis

UV is an analytical technique commonly used to find the quantity or concentration of the sample using the calibration curve. It mainly works on conjugated systems (double bond and stuff). UV-Vis. has high radiation energy with wavelength ranging from 10 to 800 nm; when UV is beamed at structures, electrons in σ and π bonds were transmitted from stable to unstable electronic excited state. If the bond breaks, the whole molecule will collapse as these are the bonds that hold the molecules together. These bonds are also strong and require a UV radiation of <150 nm. As a result, radiations less than 150 nm were of no use in the present investigation. However, if the weak bond was excited to [$\pi*$] in unsaturated systems, there would be no harm, a reading can be obtained without damaging the molecule. Fig. 2 shows that Cu-salpn has a maximum absorbance of 250.1 nm.

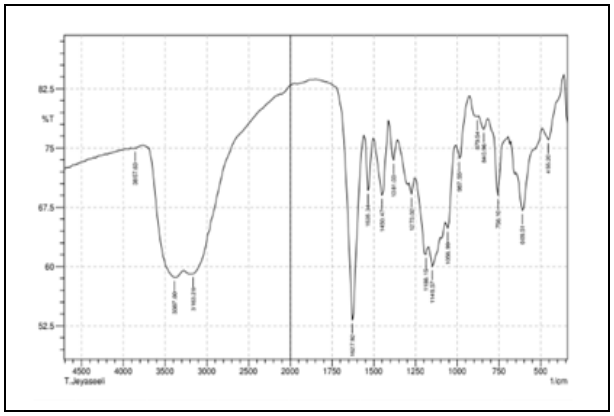


Fig. 1: FT-IR analysis of Cu-salpn complex

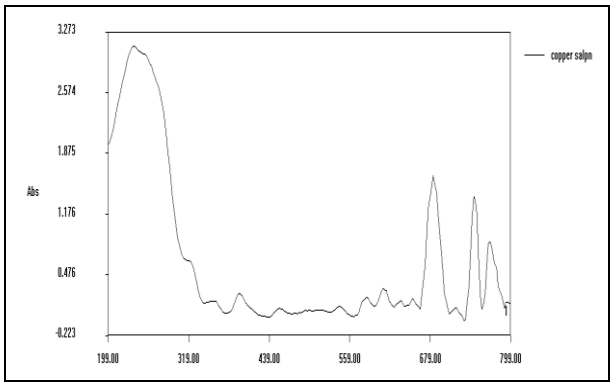


Fig. 2: UV analysis of Cu-salpn complex

3.3 Antimicrobial Activity

Cu-salpn is well known as one of the most antimicrobial nano-substances (Parastoo *et al*. 2002). The antimicrobial activity of the synthesized Cu-salpn complex against bacteria such as *Antinomyces israelii*, *Corynebacterium diphtheria* and *Staphylococcus aureus* was tested by using Agar well diffusion method (Shahidi *et al*. 2004). Petri plates containing 20 ml nutrient agar medium were seeded with 24-hour culture of bacterial strains (*Antinomyces israelii*, *Corynebacterium diphtheria* and *Staphylococcus aureus*) were cut, and the sample was added at different concentrations (Cu-salpn - 50, 100, 250 and 500 µg/ml). The plate was incubated at 37 °C for 24 h. The antibacterial activity was assayed by measuring the diameter of the inhibition zone formed around the wells (Reddy *et al*. 2001). Gentamicin antibiotic was used as a positive control. The values were calculated using GraphPad Prism 6.0 software (USA).

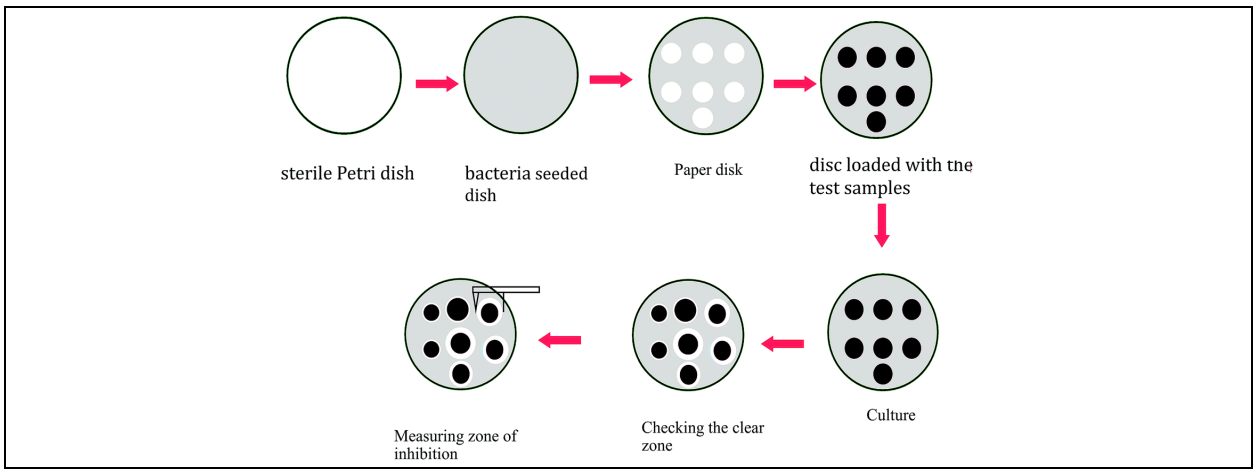


Fig. 3: Agar Well Diffusion Method

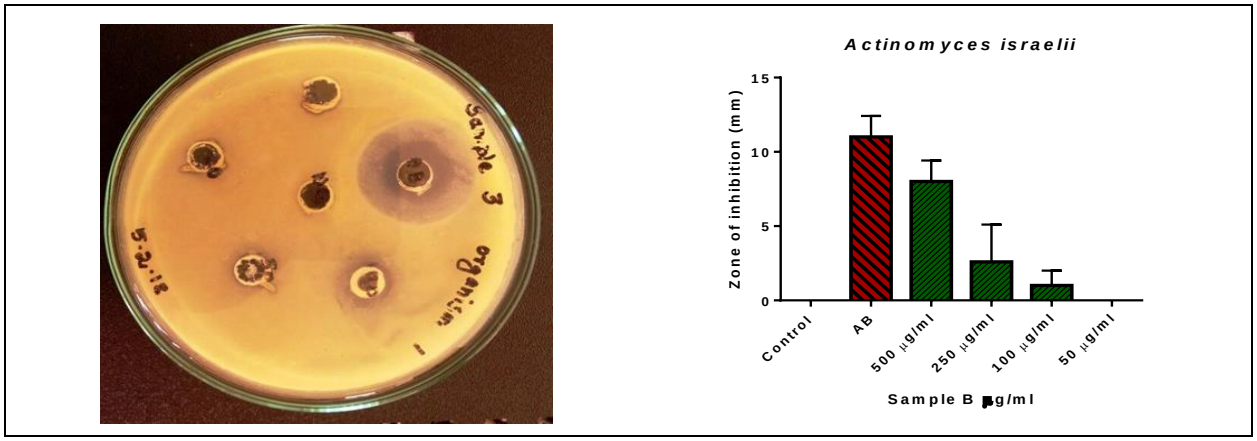


Fig. 4: Zone of inhibition obtained by Cu-salpn against *Antinomyces israelii*

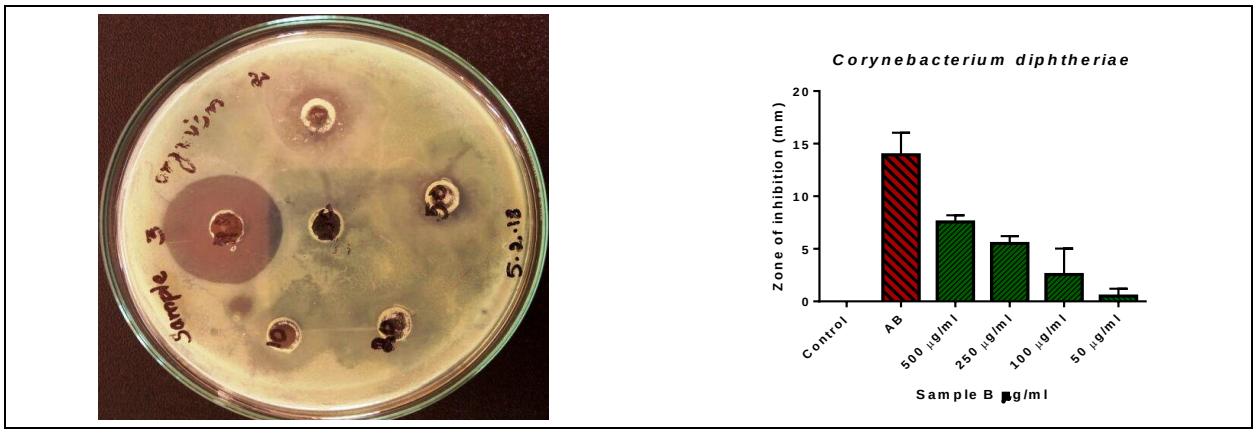


Fig. 5: Zone of inhibition obtained by Cu-salpn against *Corynebacterium diphtheria*

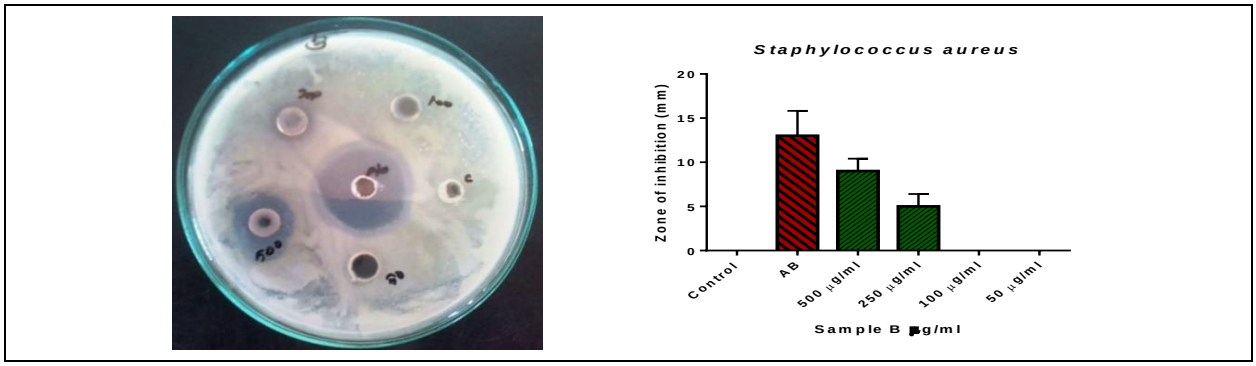


Fig.6. Zone of inhibition obtained by Cu-salpn against *Staphylococcus aureus*

Table 1. Cu-salpn - Zone of inhibition (mm)

S. No.	Name of the organism	Control	Antibiotic	50 µg/ml	100 µg/ml	250 µg/ml	500 µg/ml
1	*Antinomyces israelii*	0	11	0	1	2.6	8
2	*Corynebacterium diphtheria*	0	13.9	0.5	2.5	5.5	7.5
3	*Staphylococcus aureus*	0	13	0	0	5	9

4. CONCLUSION

The biological activity of the transition metal complexes derived from the Schiff base ligands has been studied and characterized. Schiff base ligands are considered privileged ligands because they are easily prepared by a simple one-pot condensation of aldehyde and primary amines. The results obtained have shown that transition metal complexes have significantly improved antibacterial activity than the parent compound. As evident from Table 1, the best antibiotic effect was observed with *Corynebacterium diphtheria* than *Antinomyces israelii* and *Staphylococcus aureus.*

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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REFERENES

Nair, R., Shah, A., Baluja, S. and Chanda, S., Synthesis and antibacterial activity of some schiff base complexes, *J. Serb. Chem. Soc*., 71(7), 733–744(2006). https://doi.org/10.2298/JSC0607733N

Navan R., Bhalodia, Shukla, V. J., Antibacterial and antifungal activities from leaf extracts of *Cassia fistula*: An ethnomedicinal plant, *J. Adv. Pharm. Technol. Res.*, 2(2), 104-109(2011). https://doi.org/10.4103/2231-4040.82956

Parastoo Karimi Alavijeh, Parisa Karimi Alavijeh and Devindra Sharma, A study of antimicrobial activity of few medicinal herbs, *Asian J. Plant and Research*, 2(4), 496-502(2002).

Reddy, P. S., Jamil, K., Madhusudhan, P., Anjani, G. and Das, B., Antibacterial activity of isolates from *Piper longum* and *Taxus baccata*, *Pharmaceutical Biol*., 39(3), 236–238(2001). https://doi.org/10.1076/phbi.39.3.236.5926

Rishu Katwal, Harpreet Kaura and Brig Kishore Kapur, Application of Copper- Schiff's Base Complexes : A Review, *Sci. Revs. Chem. Commun*., 3(1), 01-15(2013).

Salehia, M., Kubickib, M., Dutkiewiczb, G., Rezaeic, A., Behzada, M. and Etminania, S., Synthesis, Characterization, Electrochemical Studies and Antibacterial Activities of Cobalt (III) complexes with SalpnTipe schiff base ligands. Crystal Structure of trans $[Co^{III}(L^1)(Py)_2]ClO_4$, *Russian Journal of Coordination Chemistry*, 39(10), 716–722(2013). https://doi.org/10.1134/S1070328413100084

Shahidi, B. H., Evaluation of antimicrobial properties of Iranian medicinal plants against Micrococcus luteus, Serratia marcescens, Klebsiella pneumonia and Bordetella bronchoseptica, *Asian J. Plant Sci*., 3, 82–86(2004). https://doi.org/10.3923/ajps.2004.82.86