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SYNTHESIS, CHARACTERISATION AND ANTI MICROBIAL ACTIVITY OF A NOVEL POLYMERIC COPPER (II) COMPLEX

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ABSTRACT

A novel polymeric Copper (II) complex containing $[\{Cu_2L(O_2CCH_2NH_2)\}]_X$ pentadentate Schiff base ligand has been prepared from the precursor complex pentadentate Schiff base ligand. The precursor complex was prepared from 1:2:2 molar ratios of Copper sulphate, glycine and sodium hydroxide. The synthesized polymeric Copper (II) complex was characterised by using UV-Visible spectra and FT-IR spectra. The synthesized Copper (II) complex and the precursor and the Schiff base ligand were screened for their antibacterial activity against Staphylococcus aureus, Klebsiella pneumonial, E-Coli, Pseudomonas aeurginosa and antifungal activity against Aspergillus niger, Penicillium spp. Candida tropicalis and Candida albicans. The complex was found to be inhibitory to all the selected micro organisms except Aspergillus niger and Penicillium spp. Both Schiff base ligand and precursor didn't show any inhibition to all the selected micro organisms.

KEYWORDS: Copper (II) complex, E-Coli, Pseudomonas aeurginosa and Candida albicans.

1. INTRODUCTION

Copper is also an essential material of the future.[1-3] Solar heating, large-scale desalination of water, the linear motor are all innovations where copper will make an increasingly important contribution. The known reserves of copper ore are ample for all envisaged requirements, and continuous metallurgical research promises to provide new alloys possessing even superior properties to meet the exacting demands of the technology of the 21st Century. Copper in complexes exists Cu(I), Cu(II) and Cu(III) forms, Cu(III), being very easily reduced, is generally regarded as uncommon but it has now received importance because of its involvement in some biological processes. K_3CuF_6 is the only high spin Cu (III) complex, the rest being low spin diamagnetic.[4-9] Cu(II) forms stable complexes with nitrogen and oxygen donor ligands. Cu(II) may undergo redox reactions with thiol groups of proteins. The Cu(II) complexes of nitrogen ligands are generally more stable than Cu(I) complexes.[10-15]

2. MATERIALS AND METHODS

Copper (II) Sulphate and glycine were purchased from S.D. Fine chemicals and 1,3-diamino–propan-2-ol was purchased from Aldrich. Acetylacetone, sodium hydroxide and piperidine were purchased from S.D. Fine chemicals. All the solvents and chemicals were of A.R. grade and used as received.

3. PREPARATION OF PRECURSOR COMPLEX $[Cu_2 (OOCCH_2NH_2)_4(H_2O)_2]_n$

An aqueous solution of 40 mmoles of NaOH was mixed with 40 mmoles of glycine. Then 20 mmoles of $CuSO_4$ was taken in water. The sodium salt of glycine was added to the $CuSO_4$ solution with constant stirring and pale blue precipitate was obtained. Then the precipitate was filtered through ordinary filter paper and dried. The solubility of tetraarylcarboxylates in common solvents are generally low, except for dioxan. It has been shown that manganese carboxylates are more prone to form the binuclear complex of the binuclear complex probably occurs to an appreciable extent in an alcoholic medium. It was also pointed out earlier that the larger acid dissociation constant of the carboxylic acid does not favour the formation of the binuclear molecule. Hence larger the dissociation constant of the carboxylic acid, the more facile is the dissociation of the binuclear complex in methanol or ethanol.[16-17]

5. PREPARATION OF THE SCHIFF BASE LIGAND

The Schiff base (H_3L) was prepared (Nishida et al 1986) by reacting 1,3-diamino propan-2-ol with acetylacetone in 1:2 molar ratio in an ethanolic medium and stirred well for 15 minutes in a magnetic stirrer. The yellow solid was isolated on evaporation of the solvent.

6. PREPARATION OF THE COMPLEX $[\{Cu_2L\ (OOCCH_2NH_2)\}]_n$

1 mmol of the Schiff base (H_3L) was taken in 25 ml of ethanol and 3 mmol of piperidine was added to that, stirred well. Then 2 mmol of the precursor complex was added and heated up to 45-50 ºC in water bath with constant stirring up to 20 minutes. A bluish green solution was obtained. The solution was cooled to room temperature, filtered and the filtrate on slow evaporation gave a bluish green crystalline blocks. Then this precipitate was washed with chloroform and methanol.[18]

7. RESULTS AND DISCUSSION

1. UV – Visible spectra

The electronic absorption spectra of the Schiff base ligand (Fig. 1) have been recorded in ethanol. The λmax, nm value is at 295 nm. This band corresponds to π→π* transition and the next band at 410 nm corresponds to n→π* transition in –C=N bond. The electronic absorption spectra of the precursor (Fig.2) and metal complex $[\{Cu_2L\ (OOCCH_2NH_2)\}]_n$ (Fig.3), have been recorded in chloroform. For the Copper complex, the λmax 230nm value is at nm. The band corresponds to π→π* transition. There is no change in the λmax when compared to that of the ligand's π→π* transition. The other band in metal complex is at 375 nm which corresponds to n→π* transition in –C=N bond. There is a change when compared with the ligand n→π* transition in –C=N due to the complexation.[19-21]

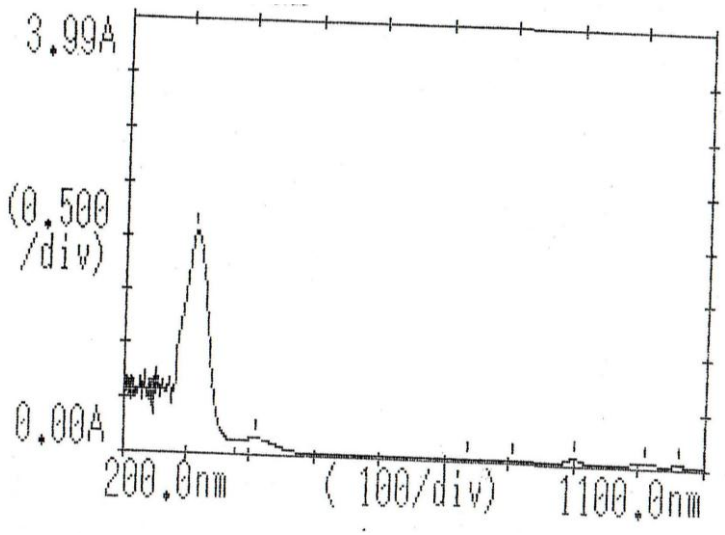


Fig. 1 UV-Visible spectra for Schiff base ligand.

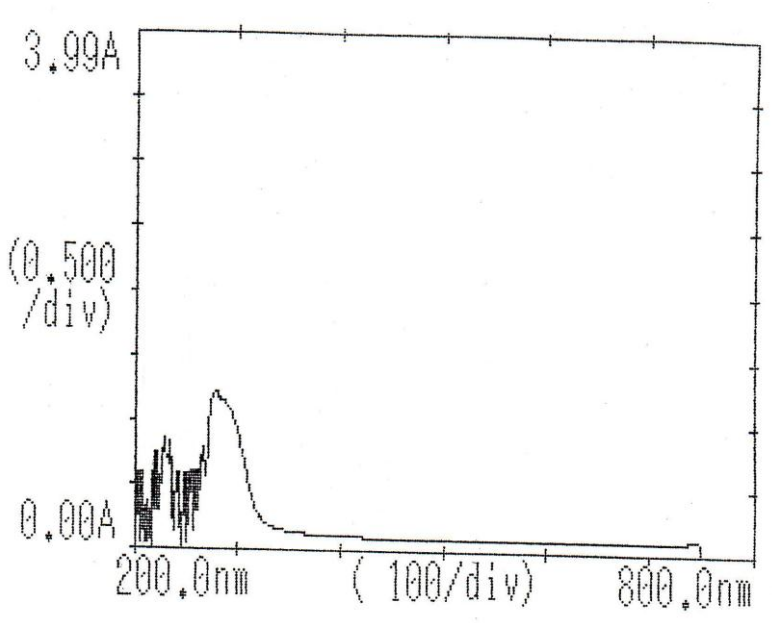


Fig 2. UV-Visible spectra for Precursor complex.

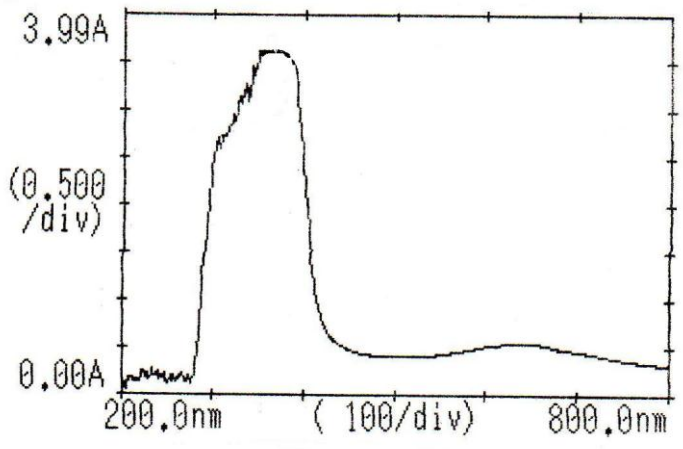


Fig 3. UV-Visible spectra for Copper complex.

2 FT-IR Spectra

The υ_s (-CH=N) at 1633 cm^{-1} for the Schiff base ligand appears at 1583 cm^{-1} for the complex. The peak at 1534 cm^{-1} corresponds to υ_s (OCO) vibration of bridging carboxylate and at 1607 cm^{-1} is due to υ_s (OCO) of the precursor complex and the corresponding peaks for the complex observed at 1645 cm^{-1} and 1197 cm^{-1} respectively. The peak at 3342 cm^{-1} in the precursor complex corresponds to the alcoholic –OH (υ_s) group and at 3375 cm^{-1} is due to H_2O peak for complex in complex spectra.[22- 25]

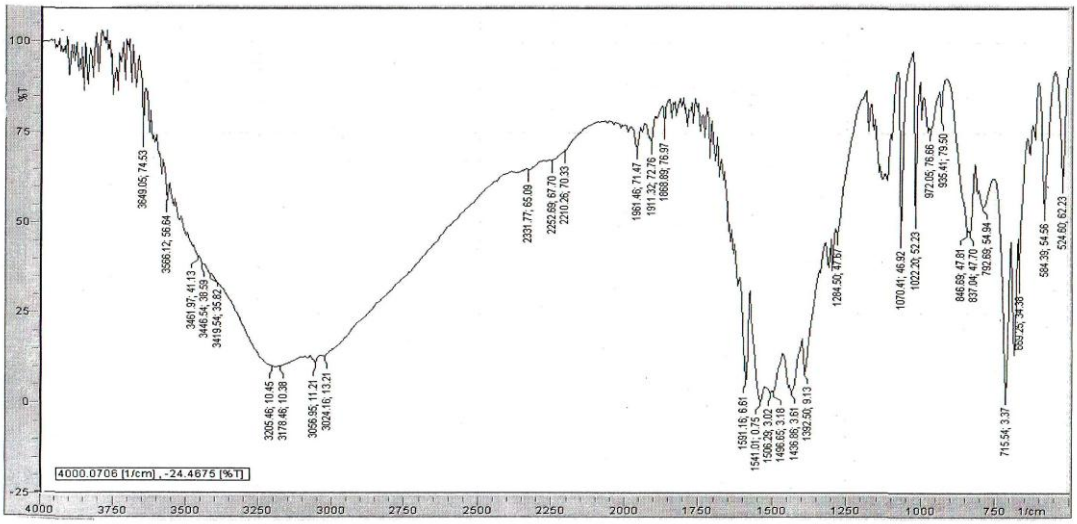


Fig 4. FT IR spectrum of Precursor Complex.

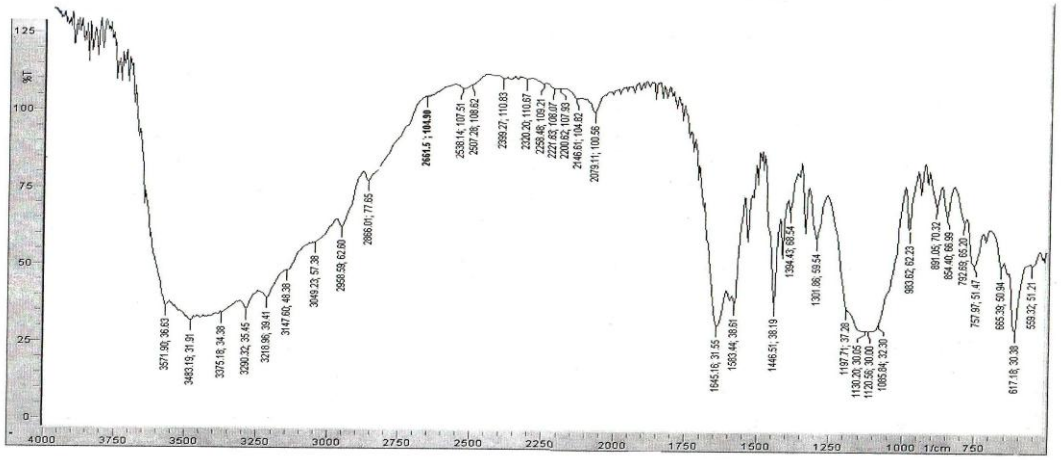
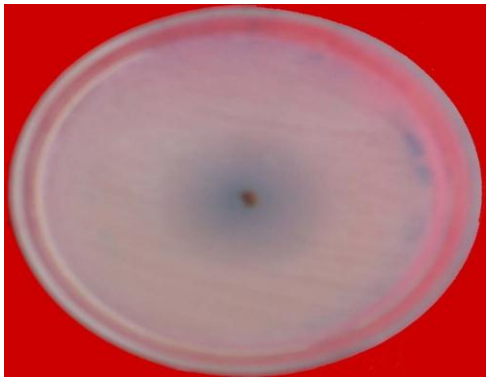


Fig 5. FT IR spectrum of Copper Complex.

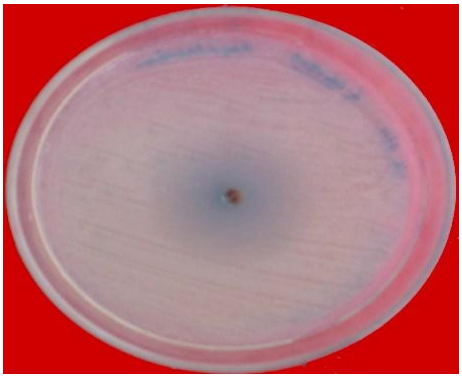
3. ZONE OF INHIBITION

ZONE OF INHIBITION (mm) FOR SELECTED BACTERIA

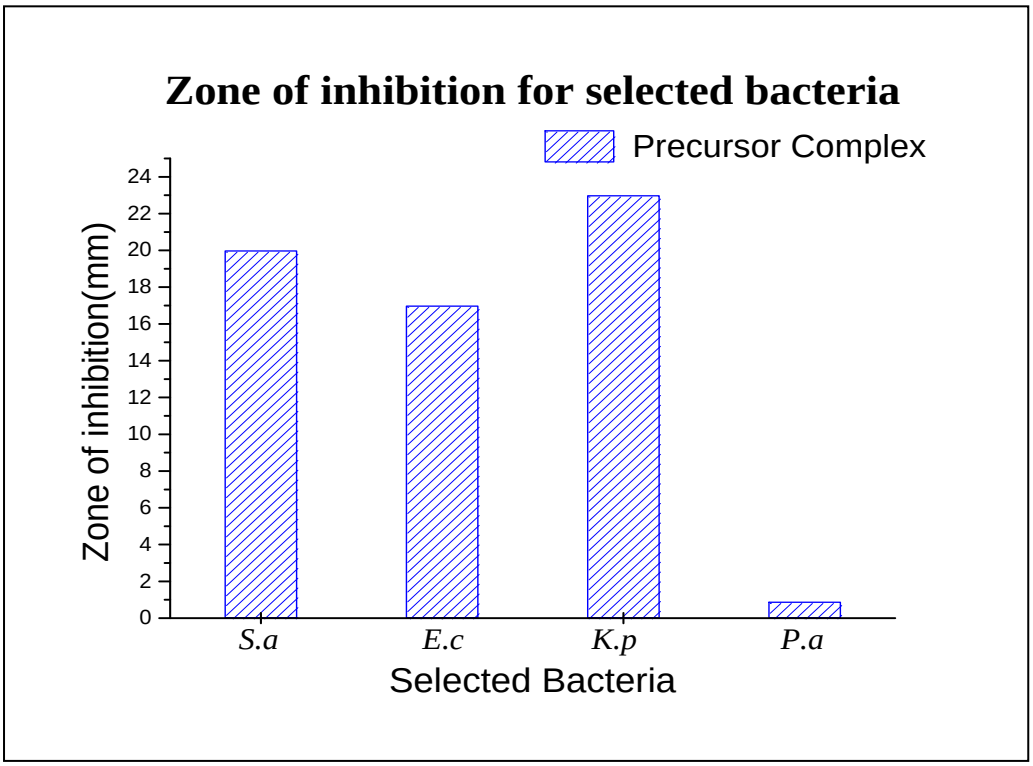
S. No	Name of the Organisms	Antibacterial activity		
		Schiff base ligand	Precursor	Complex
1.	*Staphylococcus aureus*	-	20	19
2.	*Klebsiella pheumonial*	-	17	17
3.	*E.Coli*	-	23	24
4.	*Pseudomonas aeurginosa*	-	0.9	0.9

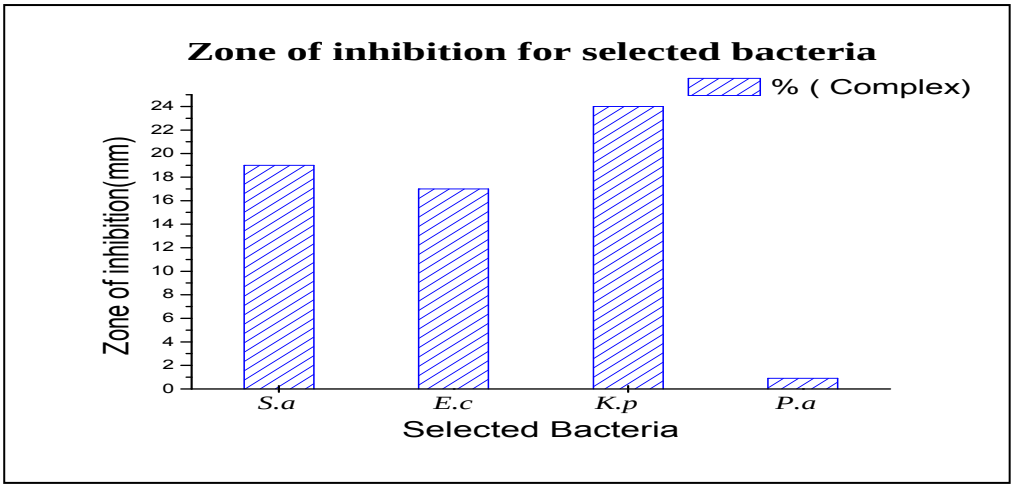


Zone of inhibition shown for *Staphylococcus aureus* by precursor.



Zone of inhibition shown for *Staphylococcus aureus* by complex.

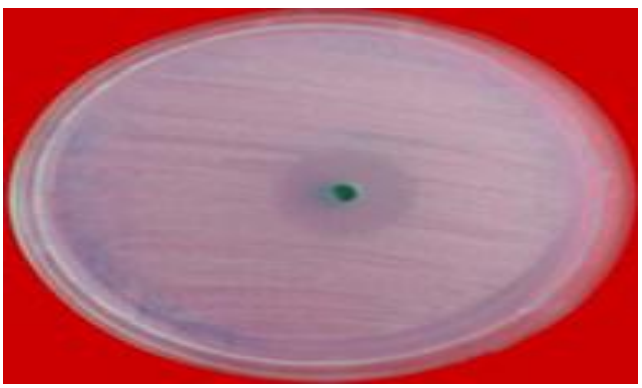




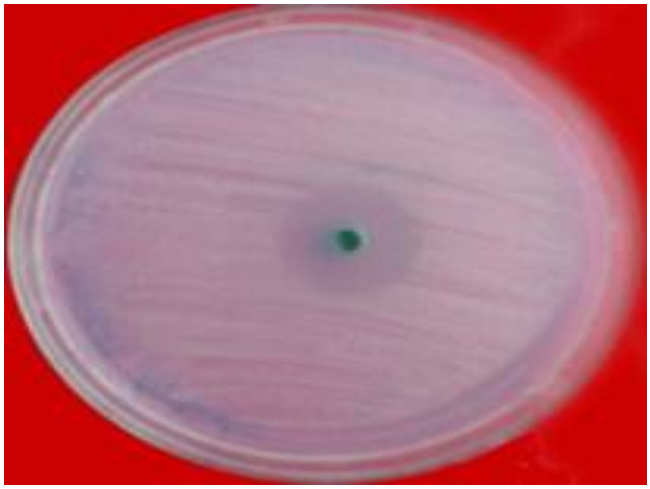
For the complex the zone of inhibition is equal to 19 mm in the case of *Staphylococcus aureus.* The zone of inhibition is 24 mm for the complex in the case of *Klebsiella pneumonial*. In *E-coli*, it was observed that the zone of inhibition is 17 mm for the complex. The zone of inhibition is 0.9 mm for the complex in *Pseudomonial aeurginos.*[26-31] The complex is found to be inhibitory to all the selected micro organisms except *Aspergillus niger and Penicillium spp,*. Thus it can be considered as a broad spectrum antimicrobial agent for the surface sterilization of equipments. The complex has an comparable inhibitory activity against bacteria chosen and the fungi. The complex can be considered as antimicrobial agent and its activity can be increased by increasing its concentration.

ZONE OF INHIBITION (mm) FOR SELECTED FUNGI

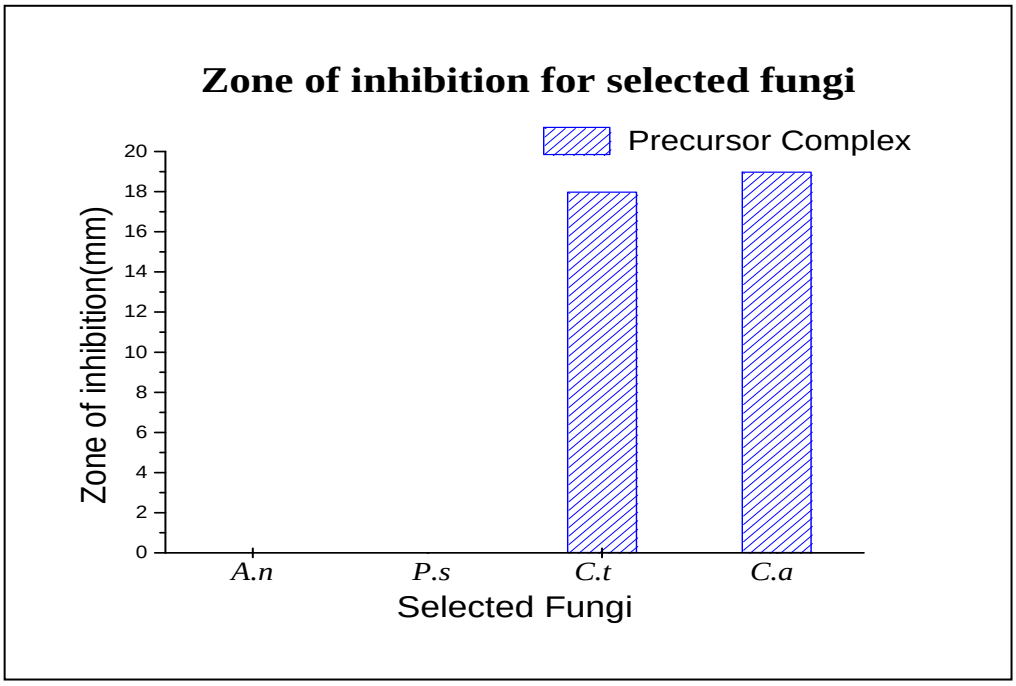
S. No	Name of the Organisms	Antifungal activity		
		Schiff base ligand	Precursor	Complex
1.	*Aspergillus Niger*	-	-	-
2.	*Penicillium Spp.*	-	-	-
3.	*Candida tropicalis*	-	18	19
4.	*Candida albicans*	-	19	20

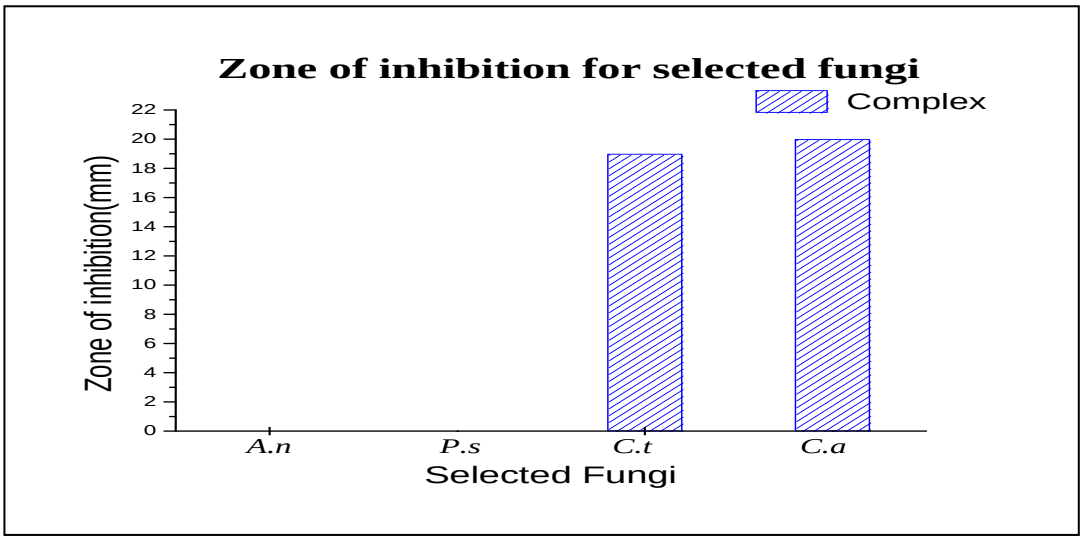


Zone of inhibition shown for *Candida tropicalis* by precursor



Zone of inhibition shown for *Candida tropicalis* by complex





4 CONCLUSION

A novel polymeric Copper (II) complex containing pentadentate Schiff base ligand has been prepared. The synthesized polymeric Copper (II) complex was characterised by using UV-Visible spectra and FT-IR spectra. The synthesized Copper (II) complex and the precursor and the Schiff base ligand were screened for their antibacterial activity against *Staphylococcus aureus, Klebsiella pneumonial, E-Coli, Pseudomonas aeurginosa* and antifungal activity against *Aspergillus niger, Penicillium spp. Candida tropicalis* and *Candida albicans.* The complex was found to be inhibitory to all the selected micro organisms except *Aspergillus niger* and *Penicillium spp.* Both Schiff base ligand and precursor didn't show any inhibition to all the selected micro organisms.

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