



DNA BINDING AND ANTIMICROBIAL ACTIVITY OF MIXED VALENT COMPLEX OF MOLYBDENUM

*V. K. Srivastava

Chemical Research Laboratory Department of Chemistry D.S. College Aligarh-202001.

*Corresponding Author: V. K. Srivastava

Chemical Research Laboratory Department of Chemistry D.S. College Aligarh-202001.

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ABSTRACT

Molybdenum complex with trithiocarbonate ligand was synthesized and characterized by elemental analyses, IR, ^1H NMR, UV-VIS, conductance measurements. The interaction of the complex with DNA was investigated the results show that the complex mainly binds to the double helix of DNA with intercalation mode. complex showed good antimicrobial activity higher than ligand.

KEYWORDS: Spectra, DNA Binding, Antimicrobial.

INTRODUCTION

The Chemistry of coordination compounds^[1,2] has become a highly specialized branch of science. A wide variety of biological systems are affected by the bases themselves and also by their metal complexes. It has become clear that nucleic acid play active role and diverse roles in nature in the past few decades. Molybdenum form multinuclear compound with trithio carbonate ligand The Synthesized complex showed DNA binding properties and good Antimicrobial activity higher than ligand.

The complex was synthesized and characterized by elemental analysis, molar conductance, IR, Electronic NMR Studies. Further complex was investigated for DNA binding antimicrobial properties.

MATERIALS AND METHODS

All the chemicals used were of analytical, reagent grade and the solvents were dried and distilled before use according to a standard procedure.^[3]

C, H and S contents were determined by Perkin Elmer 2400 elemental analyzer, IR spectra were recorded in the range $4000\text{ cm}^{-1} - 100\text{ cm}^{-1}$ with a Bruker IFS66V in KBr and polyethylene medium for compound. The Molar Conductance of the complex in DMF (10^{-3}M) Solution was measured at $27 \pm 3^\circ\text{C}$ with an Elico Model conductivity meter. UV-visible spectra were recorded in DMF with Perkin-Elmer Lambda 35 spectrophotometer in the range of 200-800 nm. ^1H NMR spectra recorded on Bruker 300 Hz spectrophotometer using DMSO d_6 as solvent. Chemical shifts are reported in ppm relative to tetra methyl silane, using the solvent signal as internal

reference. The DNA binding experiments was performed in Tris-HCl/NaCl buffer (10 mm Tris-HCl 50 mm NaCl buffer, pH 7.4) The concentration of the DNA used for binding experiments was determined by measuring the absorption intensity at 265 nm with molar extinction Coefficient value $6000\text{ M}^{-1}\text{ cm}^{-1}$. The Absorbance measurements were performed by keeping the concentration of the complex constant ($1 \times 10^{-4}\text{M}$) while varying The DNA concentrations ($1 \times 10^{-4}\text{M}$, 5, 10, 15, 20 and 25 μL) The intrinsic binding constant K was determined according to base pairs, $\sum A$, $\sum F$ and $\sum B$ corresponds to the extinction Coefficient for the absolutely bound Molybdenum complex, Free Molybdenum complex and the actually bound Molybdenum complex respectively K was obtained from the ratio of the slope to the Y- intercept. $[DNA]/(\sum A - \sum F) = [DNA]/(\sum B - \sum F) + 1/k(\sum B - \sum F)$

The antibacterial and antifungal activity of the ligand and complex were assayed against some of the bacteria and Fungai. The Cup plate method was used to assay antibacterial activity against C. diphtheria, E. Coli and antifungal activity against C. albicans and A. niger The solvent used was dimethylformamide (DMF) and the sample concentration was 50-500 $\mu\text{g/mL}$. the results were compared against the controls which were screened simultaneously. The activity was measured by measuring the diameter of the inhibited Zone in millimeters (mm) Tetracycline and amphotericin are the standard compounds used for bacterial and Fungal species.

Synthesis of Ligand and Its Complex

0.1 mole of Potassium Phenyl trithiocarbonate was dissolved in minimum amount of water and in separate Beaker 0.1 mole of Ammonium dithiomolybdate was dissolved in water (at 60°C). Now Solution of $(\text{NH}_4)_2\text{MoO}_4$ was slowly added to solution of Trithiocarbonate and Then Kept for 10-15 minutes on water bath at 80-90°C. The resulting Solution was concentrated and cooled to get Pink solid. The product thus obtained washed with cold water, and subsequently dried under reduced pressure. yield: 0.409g (72%).

RESULTS AND DISCUSSION

The complex is insoluble in common solvents such as water, benzene, chloroform, dichloromethane etc. It is Soluble in DMF and DMSO so the single Crystal could not be obtained. The result of elemental analysis is in good agreement with the calculated values. the metal content of the Complex was determined according to literature method.^[4]

The electrolytic nature of the complex is measured in DMF at 10^{-3}M . The molar conductivity exist at $8\ \Omega^{-1}\text{cm}^2\text{mol}^{-1}$ it showed that complex was non electrolyte in nature.^[5]

IR absorption bands at 940 cm^{-1} indicating the terminal Mo-O Stretching vibration. There is also an significant

absorption at 340 cm^{-1} indicating Mo-S bonding due to Sulphur of - SH group. The absorption band at near 475 cm^{-1} is Characteristic of bridging Sulphur atom. It is a mixed valent compound.

The electronic absorption spectrum^[6] of metal complex in the visible region shows two transition bands in the region around around 25000 cm^{-1} and 12195 cm^{-1} respectively. The diffuse reflectance spectrum of the Molybdeum complex shows the d-d transition bands in the region around 16806 and 20000 cm^{-1} which are assigned to Transitions $^4\text{T}_{1g}(\text{F}) \rightarrow ^4\text{A}_{2g}(\text{F})$ (V_2) and $^4\text{T}_{1g}(\text{F}) \rightarrow ^4\text{T}_{1g}(\text{F})$ (V_3) respectively - As the V_1 band occurs at Lows energy it is not observed in complex The above mentioned bands are probably a combination of the sulphur to metal Transition and S Mo charge Transfer band. ¹H NMR Spectrum^[7] of the Ligand and its Molybdenum Complex were recorded in DMSO- d_6 The ¹H NMR Spectrum of the Ligand shows the following signals = C-CH₃ proton at 2.4 ppm (S, 6H), Phenyl as multiplied at 6.9 – 7.5 ppm (m, 20H) and the peak at 13.4 ppm (S, 2H) is attributable to the phenolic – OH group. A singlet observed at 3.14 – 3.56 is the Parent Trithio – Carbonic acid and assigned for SH Proton is found to be absent in the spectra of corresponding complex indicating the deprotonation of SH group and The formation of Mo – S band.

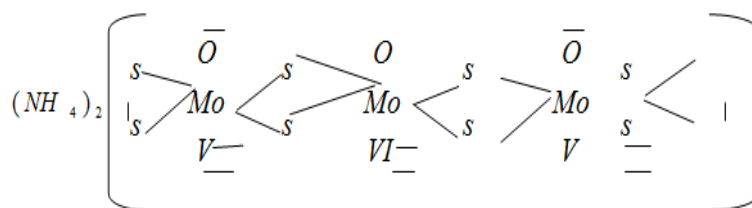


Fig. 1: Structure of Molybdeuvum Complex.

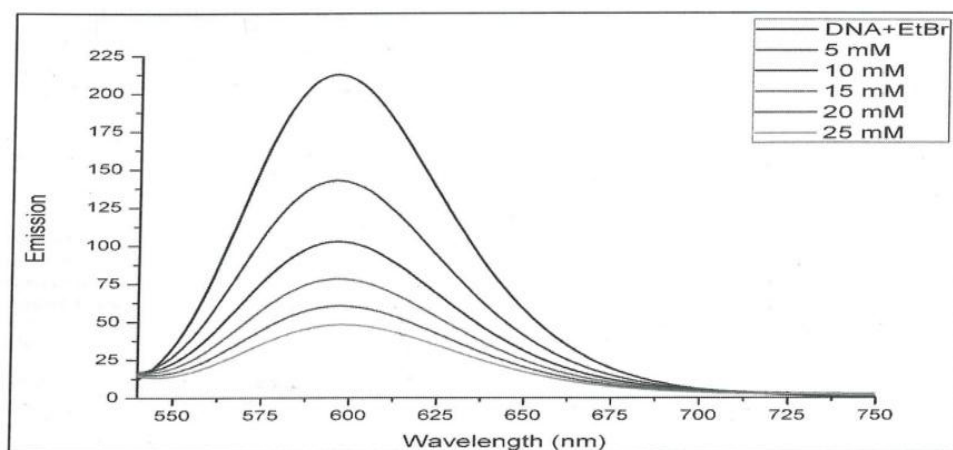


Fig. 2: Fluorescence quenching curves of ethidium bromide bound to DNA in presence of metal complex.

Electronic absorption spectroscopy is universally employed to determine the binding characteristics of metal complex with DNA The absorption spectra of Molybdenum complex in absence and presence of CT-

DNA.^[8] Shown in Fig-2 from Fig-2 it is clear that hyperchromicity is observed on the addition of CT-DNA. This significant hyper chromism effect suggest that there exist a strong interaction between the complex and CT-

DN A In addition to the decrease in Intensity a small red shift was also observed in the spectra. These spectral changes are consistent with the intercalation of the Molybdenum complex into the DNA base stack. The plot of the absorption titration data according to eq (1) gives a linear plot and results in an intrinsic binding constant (K) of $2.4 \times 10^4 \text{ mol}^{-1} \cdot \text{L}$. The results of the cup plate^[9,10]

method in table 1 showed that the Molybdenum complex is more active than Ligand. The increased lipophilicity enhanced the penetration of the complex into lipid membrane and blocking the metal binding sites on enzymes of micro organism thus retarding the normal cell process.

Table 1: Antimicrobial activity (MIC μg /mL) data.

S.No.	Compound	Antibacterial Activity		Antifungal Activity	
		C.Diphtheria	E.Coli	C.albicans	A. Niger
1.	C ₆ H ₅ SCSSK	450	500	250	200
2.	Mo ₃ H ₈ N ₂ O ₃ S ₈	100	200	150	100
3.	Tetra cycline	2.0	2.5	–	–
4.	Amphotericin	–	–	1.5	1.0

CONCLUSION

In present study Molybdenum complex was Synthesized and characterized by analytical and spectral techniques. The results from these techniques confirmed the structure of complex. Metal complex has better antimicrobial activity than Ligand. The DNA binding experiment results suggest that the interaction of the complex with DNA is by an intercalation mode.

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