ORIENTAL JOURNAL OF CHEMISTRY
An International Open Access, Peer Reviewed Research Journal
www.orientjchem.org

ISSN: 0970-020 X
CODEN: OJCHEG
2025, Vol. 41, No.(6):
Pg. 1979-1990

Therapeutic Studies of the Dioxomolybdenum (VI) Compounds of Schiff Base

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http://dx.doi.org/10.13005/ojc/410612

(Received: August 14, 2025; Accepted: November 18, 2025)

ABSTRACT

One thiophenyl azanyllidene binaphthyl-2,2′-diamine Schiff base (TABSB), one of their molybdenum parent compounds (TABSBMo), and four macrocyclic compounds (TABSBMoβs) were successfully synthesized. Their structures were analyzed comprehensively using spectroscopic techniques. This paper entails a nexus of research of the interaction between β-diketones and (TABSBMo). This article describes the characterization of five MoO_2(VI) compounds using UV-Vis, IR, NMR, and TG. Molybdenum metal will be in possession of a coordination number of six. There is a distorted octahedral arrangement geometry in each of MoO_2(VI)'s five compounds. In these compounds, the molybdenum octahedral geometry is completed by two oxidized O-atoms with four N-atoms. When it came to *S. aureus* and *S. typhi*, all of the synthesized compounds showed a mild level of effectiveness. The antibacterial job is smart manifestation pertaining to chelation hypothesis.

Keywords: Antibacterial activity, Thenil, β-diketones, macrocyclic compounds, 1,1′-Binaphthyl-2,2′-diamine and dioxomolybdenum (VI).

INTRODUCTION

A minimum of nine atoms is present in a macrocyclic compound. Among these nine atoms, a minimum of three donor sites, including all heteroatoms, are present. Macrocyclic substances have advanced considerably over the last fifty years[1–5]. Nitrogen-containing ligands and related compounds are crucial in coordination chemistry. Many research investigations that study main group complexes from biological perspectives and promote wide-ranging uses have been published[6–11]. Using metal ions, a main group Schiff base containing vitamin B6 catalyzes transamination methods[15,16]. Schiff base compounds have anti-inflammatory together as anti-cancer properties and to a greater extent with corresponding antifungals well as antiviral ones[12–30].

Schiff bases in the bioinorganic sector can be used to simulate the metal sites found in metalloproteins in consonance with enzymes[31,32]. They also still find consumer electronics, memory storage devices, and chemical interactions fascinating.

The coordination number and arrangement of extreme density ligands in transition metal complexes vary[33,34]. Molybdenum can be flexible in this regard due to its various oxidation states. Moreover, a coordination number can be between 4 and 8[32,33]. By connecting molybdenum compounds along with ligands that contain heteroatoms (N, O, and S), it is possible to construct Schiff base structures for both homogeneous and heterogeneous processes[37–41]. Since dioxomolybdenum(VI) molecules have multidentate ligands, they can be used in a variety of biological applications. In an aqueous solution, $[MoO_4]^{2-}$ is easily obtained as Mo(VI). The pH and concentration of the solution can be used to calculate the $[MoO_4]^{2-}$ ion concentration. The role of the $[MoO_4]^{2-}$ ion is smartly delineated as a template for oxygen transfer. The molybdenum oxotransferase mechanism has been demonstrated to be adversely influenced by their properties of oxygen transport[42–46]. The complete oxidation of a number of redox enzymes is known[47–49]. In these situations, their active sites are linked to a cis-dioxomolybdenum moiety.

For pathogenic bacteria that are present in vegetation, animals, and humans, the sole transition metal is molybdenum that is regarded as a biometal that is necessary[50,51]. Research on Mo(VI) coordination chemistry is ongoing due to its biological and catalytic characteristics[52–55]. The physiological activities of oxomolybdoenzymes are established by a molybdenum molecule[56–58]. Because of its versatility, thenil may be helpful as a chelating agent. The reactive carbonyl groups in thenil may cause Schiff base condensation with diamines. In the synthesis of macrocyclic ligands, di-2-furanylenedione is a crucial component.

Thenil contains denticity ligands that, in some circumstances, can be produced via the interaction of thenil with diamine. The produced chemical is cyclized with 1,3-diketones through the impact of a metal template. Molar conductivity investigations, elemental analysis, UV-Vis, TGA, ir, and nmr spectroscopy have all been used to establish their putative structures and prepare and describe them.

EXPERIMENTAL

Materials

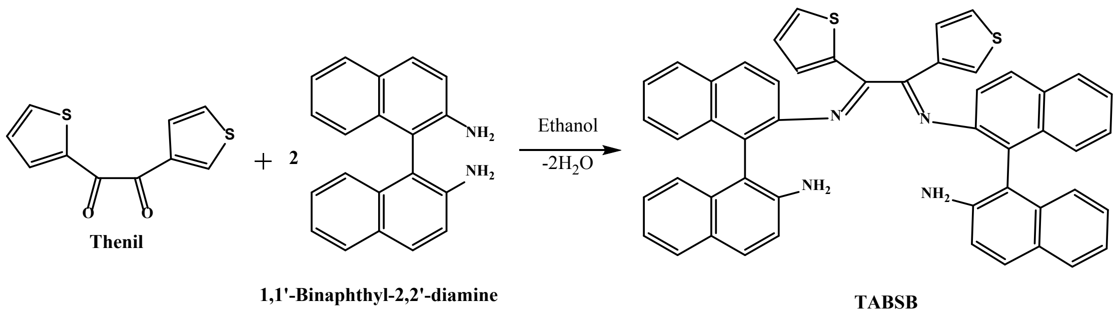
Schiff bases (ligands) and compounds were created by chemists sourced from company resources employing chemicals of reagent grade. The 1,3-diketones were derived from Aldrich without undergoing the same refining as molybdenyl acetylacetonate, 1,1′-Binaphthyl-2,2′-diamine, and thenil.

Physical Measurements and Analytical Methods

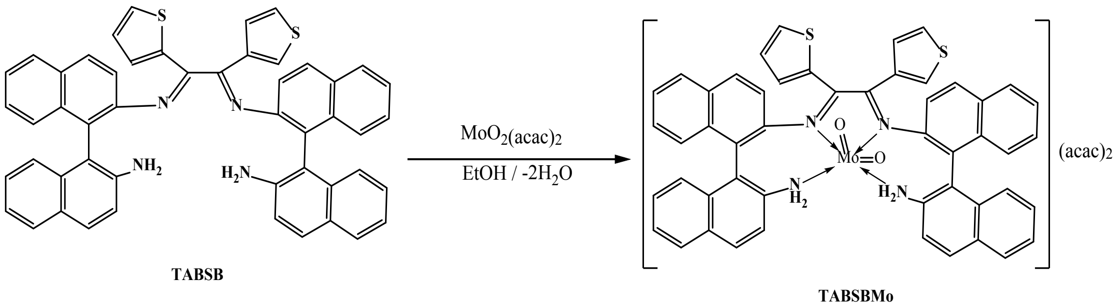
CHN analyzers were utilized to look at C, H, and N in the compounds at significant CRFs in Arunachal Pradesh, India, such as NERIST, Nirjuli, and Itanagar. Kjeldahl's method is adopted to measure nitrogen in synthetic substances. Following the compound's disintegration, the gravimetric method was employed to estimate molybdenum[59]. Sulfur estimation advanced with the development of barium sulfate as a sulfur estimation technique[60]. Compound's electronic absorption spectra were manifested using ethanol to the facility of UV spectrophotometer (Labinda) at Uttar Pradesh Textile Technical Institute, Kanpur, U.P., India. Infra-red spectra of MoO_2(VI) molecules in potassium bromide were practiced by virtue of spectrometers corresponding to Perkin-Elmer Spectrum with models of 10.03.06 and 18.03.06 at IIK. JEOL's JMM ECS-400 was utilized to furnish the proton NMR spectra of MoO_2(VI).TG recordingwas done at IITK, India. The thermal behavior of the TABSBMo compound was examined at 10°C per minute over 50-900 °C in a nitrogen conditioning.

Condensation of thenil and 1,1′-Binaphthyl-2,2′-diamine with 1,3-diketones yields molybdenum (VI) compounds with ligands

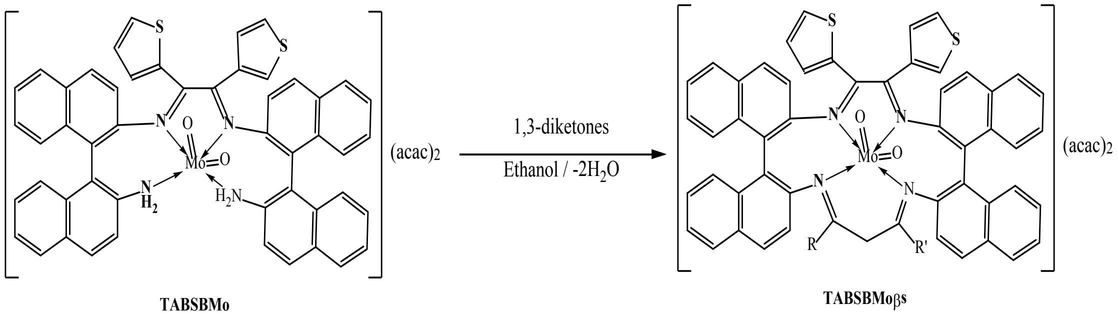
Schemes 1, 2, and 3 illustrate the synthesis of TABSBMoβs. Thenil (5 mmol, 0.9506 g) and 1,1′-Binaphthyl-2,2′-diamine (10 mmol, 2.0106 g) were added to 60 mL of ethanol after molybdenyl acetylacetonate (5 mmol, 1.6307 g) was added dropwise. After three hours of a little reflux in the reaction mixture, the solution turns brown. Following filtering, the solid product was cleaned with ethanol and then vacuum-isolated using silica gel. The TLC method was applied to verify the compound's purity. Thus, the yield of TABSB was 48%. Comparative 3D framework of Schiff base ligand TABSB along with the fountainhead TABSBMo motif is depicted in Figures 1 and 2.



Scheme 1. Synthesis of TABSB



Scheme 2. Synthesis of TABSBMo



Scheme 3. Synthesis of TABSBMoβs

Where TABSB = thenil + 1,1′-Binaphthyl-2,2′-diamine; TABSBMoβs = Synthesis of macrocyclic ligands by reaction of 1,3-diketones with TABSB in occupation of MoO_2(VI) cation.

R and R' = CH_3 for TABSBMoβs^1; R = C_6H_5, R' = CH_3 for TABSBMoβs_2; R = C_4H_3S, R' = CF_3 for TABSBMoβs_3; R and R' = C_6H_5 for TABSBMoβs_4

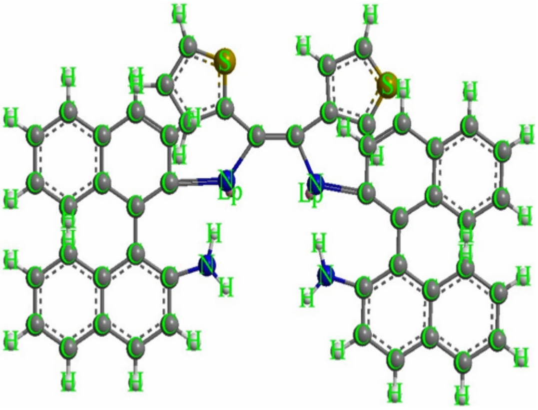


Fig. 1. TABSB3D structure

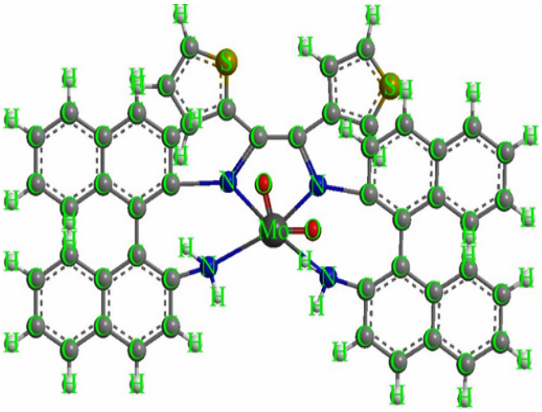


Fig. 2. TABSBMo3D structure

Reaction of 1,3-diketones to TABSBMo's alcoholic solution leads to a consistent reaction lasting for three hours. Solid macrocyclic compounds (type B), yellowish in texture, that we produced here were 1,3-diketones such as (a) 2-Thenoyltrifluoroacetone (b) dibenzoylmethane (c) 2,4-pentanedione, or (d) benzoylacetone. To confirm that macrocyclic compounds are pure, a TLC test is conducted.

Table 1: CHN data

Compound	Formula	F.W.	Yield(%)	m.p.(^{0}C)	%of Element, Calcd./(found)				
					C	H	N	Mo	S
TABSB	$C_{50}H_{34}N_4S_2$	754.97	60	118	79.55(78.95)	4.54(4.50)	7.42(7.35)	--	8.49(8.40)
TABSBMo	$C_{60}H_{48}N_4MoO_6S_2$	1081.14	50	130	66.65(66.60)	4.47(4.40)	5.18(5.11)	8.87(8.82)	5.93(5.80)
TABSBMoβs^1	$C_{65}H_{52}N_4MoO_6S_2$	1145.22	48	132	68.17(68.13)	4.57(4.50)	4.89(4.80)	8.378.31)	5.59(5.45)
TABSBMoβs^2	$C_{70}H_{54}N_4MoO_6S_2$	1207.29	50	145	69.64(69.50)	4.50(4.45)	4.644.55)	7.947.60)	5.315.22)
TABSBMoβs^3	$C_{68}H_{49}N_4MoO_6S_3F_3$	1267.29	50	128	64.44(64.38)	3.89(3.80)	4.424.35)	7.75(7.68)	7.59(7.51)
TABSBMoβs^4	$C_{75}H_{56}N_4MoO_6S_2$	1269.36	45	130	70.96(70.90)	4.44(4.20)	4.41(4.32)	7.55(7.49)	5.05(4.85)

Stoichiometric chunk of metal along with ligand are in a 1:1 ascertained by elemental analysis (Table 1)

Antibacterial activity assay

The employed method was agar-well diffusion to track the biological efficacy in the antibacterial domain of several bacterial strains, ranging from *S. aureus, B. subtilis, E. aerogene* to *S. typhi, in vitro*[61–63]. Doxycycline started to have the same antibacterial action as other medicines. We used a metallic borer to drill holes in the agar media that were 6 mm in diameter. There were $3x10^5$ colony-forming units per milliliter (mL) in all bacterial suspensions. With the use of standardized suspensions, agar was enlarged. A solution of 300 g mL^{-1} of the generated chemicals in 1% DMSO was used to analyze the sample. The evaluated samples were placed into each well. Remaining wells were occupied with 0.05 percent doxycycline inclusive of DMSO. The test for growth inhibition is conducted after the incubation at 35°C lasting for 35 hours.

RESULTS AND DISCUSSION

Infrared spectra

By refluxing a mixture of thenil, 1,1′-Binaphthyl-2,2′-diamine, Mo(acac)$_2$ in ethanol with a ratio of 1:2:1, dioxomolybdeum (VI) was created *in-situ*. The scheme illustrates the macrocyclic compounds that were synthesized. The MoO$_2$(VI) compounds and the separate ligands both showed many infrared bands. These bands are highlighted in Table 2. The lowering of νC=N absorption frequencies has been used to demonstrate a macrocyclic molecule having N-atoms of the group -C=N bound to Mo[63–67]. In spectrum bands spanning from 1566 to 1670 cm^{-1}, individual ligands exhibit a C=N signal at 1670 cm^{-1} [64–66]. The Mo-N vibration, which has nothing to do with free ligands, may be responsible for it[68]. The existence of two C=N signals at about 1710 cm^{-1} causes thenil to establish a strong bind with diamines[66,67]. The target is 3320 cm^{-1} for an N-H$_{asym}$ broad band and 3130 cm^{-1} for a N-H$_{sym}$ wide band. Since the NH group is not present, TABSBMo and TABSBMoβs are identical. This suggests that the bonding process does not involve the NH group[71]. The d-orbital is most frequently utilized for bonding among dioxomolybdenum (VI) compounds, generating preferentially cis-dioxo groups. Due to C_{2V} symmetry, cis-$[MoO_2]^{2+}$ exhibits both symmetric and asymmetric stretching at 890-990 and 962-972 cm^{-1} in dioxomolybdenum(VI) compounds[72]. The vasymand νsym(O=Mo=O) dioxomolybdenum frequencies are linked to twin IR bands at the concerned wavelengths, correspondingly[72–79]. νsym dioxomolybdenum has higher vibrations than νasym(O=Mo=O)[80,81]. The acetylacetonate bands close to 1550–1565 of C=O and 1455–1480 cm^{-1} C=C vibrations[82]. An equal arrangement of IR bands is displayed by the macrocyclic substances. Both the vibrations of the amino group tagged terminally vanish when 1,3-diketones are cyclized by adding -C=O groups to the -NH$_2$group[82,83].

Table 2: IR spectral bands of the compounds

Compound	C=N	Mo-N	C=O(acac)	C=C(acac)	ν of asym(O=Mo=O)	sym(O=Mo=O)	asym(N-H)	ym(N-H)
TABSB	1670m	---	---	---	---	---	3320br	3130br
TABSBMo	1566s	493m	1492m	1397s	915s	972s	---	3122br
TABSBMoβs¹	1652m	550s	1552s	1465m	895m	965s		
TABSBMoβs²	1630s	558s	1555s	1470s	910m	970m		
TABSBMoβs³	1650s	565m	1550m	1455m	990m	965m		
TABSBMoβs⁴	1655m	540s	1560s	1472s	895s	962s		

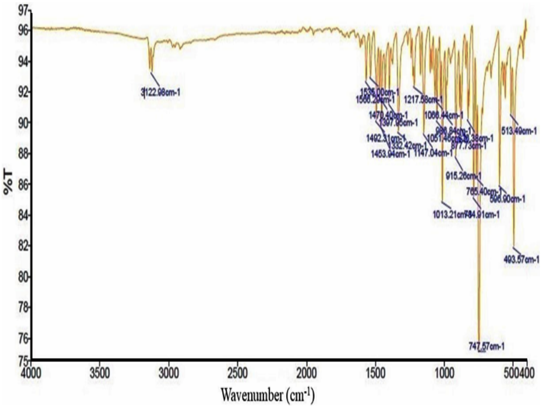


Fig. 3. IR spectrum of TABSBMo

^{1}H NMR spectra

Table 3 represents all NMR signals. Holistic NMR signals are accustomed to paragraphs. All ^{1}H NMR of MoO_2(VI) compounds in relation to the ligand were examined using DMSO-D_6. The cyclization via 1,3-diketones may be indicated by the presence of NH_2 at δ (5.49) in TABSB, which is also present in TABSBMo at δ (7.20) but absent in the rest compounds[87–89]. The ten protons in molybdenum compounds, including ligand, are multiplets in the δ (8.95-7.20) range. The protons of aromatic rings showed peaks at δ 8.30. Two varieties of azomethine are available for use in the macrocyclic compound's production, and they seem to cause these chemical changes. The bond to CH_3 of the diketone group may be the cause of the peak at δ 0.87.

Table 3: ^{1}HNMR data (in δ ppm)

Compound	HC-Binaphthyl	HC-thiophene	N-H	HC-CH_3	HC-CH_2	HC- thienyl	HC-Ar
TABSB	8.06, 2H; 8.20, 2H; 7.39, 2H; 7.52, 2H; 8.95, 2H; 8.80, 2H, 7.25, 2H; 7.20, 2H; 7.97, 2H; 7.89, 2H; 7.76, 2H	7.53, 2H; 7.98, 2H; 7.01, 2H	5.49, 4H	---	---	---	---
TABSBMo	8.06, 2H; 8.20, 2H; 7.39, 2H; 7.52, 2H; 8.95, 4H; 7.52, 2H; 7.39, 2H; 8.20, 2H; 8.06, 2H; 7.18, 2H	7.53, 2H; 7.69, 2H; 7.01, 2H	7.20, 4H	---	---	---	---
TABSBMoβs¹	8.06, 2H; 8.20, 2H; 7.39, 2H; 7.52, 2H; 8.95, 4H; 7.52, 2H; 7.39, 2H; 8.20, 2H; 8.06, 2H; 7.69, 2H	7.53, 2H; 7.69, 2H; 7.01, 2H	---	0.87, 6H	1.05, 2H	---	---
TABSBMoβs²	8.06, 2H; 8.20, 2H; 7.39, 2H; 7.52, 2H; 8.95, 4H; 7.52, 2H; 7.39, 2H; 8.20, 2H; 8.06, 2H; 7.69, 2H	7.53, 2H; 7.69, 2H; 7.01, 2H	---	0.87, 3H	1.05, 2H	---	7.30, 2H; 7.42, 2H; 7.45, 1H
TABSBMoβs³	8.06, 2H; 8.20, 2H; 7.39, 2H; 7.52, 2H; 8.95, 4H; 7.52, 2H; 7.39, 2H; 8.20, 2H; 8.06, 2H; 7.69, 2H	7.53, 2H; 7.69, 2H; 7.01, 2H	---	---	1.05, 2H	7.15, 1H; 7.01, 1H; 7.53, 1H	---
TABSBMoβs⁴	8.06, 2H; 8.20, 2H; 7.39, 2H; 7.52, 2H; 8.95, 4H; 7.52, 2H; 7.39, 2H; 8.20, 2H; 8.06, 2H; 7.69, 2H	7.53, 2H; 7.69, 2H; 7.01, 2H	---	---	1.05, 2H	---	7.30, 4H; 7.42, 4H; 7.45, 2H

UV-Visible spectra

The strong energy scheme proposed by the TABSB and molybdenum(VI) compounds is in agreement with these spectra, which were obtained in ethanol[84,85]. The spectra of molybdenum(VI) compounds and TABSB are comparable. The Mo(VI) ion is no longer anticipated to exhibit a pure d-d transition since it lacks a d-electron. It is also possible to think of all prepared Mo compounds as electronic transitions [N(π)βd(Mo)] between d-orbitals of Mo and N. The UV-VIS spectra of a dioxomolybdenum(VI) molecule with N- atoms are uniform. Transitions like intraligand and n→π*/π→π* may be responsible for the strong absorption bands seen at 285 nm and 305 nm in those compounds' UV-Vis spectra.

N(π)$\rightarrow$d(Mo) appears to be the cause of the band between 370 and 385 nm. Electronic transition between LUMO of the Mo-atom and HOMO of the ligand is most facilitated by transition ${}^2B_2 \rightarrow {}^2A_1$/ (dxy$\rightarrow$dx^2-y^2), which may be covered by other transitions. Using Ballhausen-Gray diagrams, the energy level of such compounds has been provided. The electronic spectra of each molecule is distorted by an octahedral pattern[90].

Magnetic and molar conductance measurements

It is not required to mention the diamagnetic nature of dioxomolybdenum (VI) compounds in the d^0 configuration. Since d-orbitals lack electrons in such compounds, no d-d transitions are found. Ratio 1:1 sort electrolytes are supported by the molar conductivities (Λ_M) of every Mo compound in DMF at about 10^{-3} M. The molar conductance of such substances fluctuates between 92 and 115 Ω^{-1} cm^2 mol^{-1}. Above compounds of type TABSBMo and TABSBMoβs, the molar conductance values indicate tentative forms, as the schemes.

Thermogravimetric analyses

According to the compound's thermogravimetric curve (TG Curve), the compound broke down in a single step. The loss of the TABSB and acetylacetonate (estimated weight of 83.1%) is the cause of the observed 83% weight loss at 279°C. MoO_3 makes up 16.3% of the residual at 281°C. MoO_2 is responsible for the 14.48% weight remaining at 324°C.

Antibacterial activity

The dioxomolybdenum (VI) compounds have antibacterial action, as shown in Table 4. MoO_2(VI) complexesshowedbactericidal activity against a range of bacteria. We have taken a variety of bacterialike *S. aureus, B. subtilis, E. aerogenes*, and *S. typhi*. The enhanced antibacterial activities of compounds can be explained by the chelation hypothesis[82,83]. A doxycycline cure serves as the source of information. The activity of many of the compounds in response to *S. aureus* and *S. typhi* was found to be low or moderate.

Employing Eq. 1 at the outset, an estimation of the inhibition effect (%) was executed depending on the +ve control

$$\%\ inhibition\ effect = \frac{extract\ inhibition\ halo\ diameter}{positive\ controlinhibition\ halo\ diameter} X\ 100 \qquad (1)$$

Table 4: Antibacterial activities of compounds*

Compound	*S. aureus*	*E. aerogenes*	*S. typhi*	*B. subtilis*	*Doxycycline*
TABSBMo	16	19	19	22	25
TABSBMoβs^1	14	20	18	20	23
TABSBMoβs^2	15	20	18	20	24
TABSBMoβs^3	13	19	17	--	24
TABSBMoβs^4	17	18	--	21	23

*Inhibition zone activity (mm): 23-26 = strong; 15-18 = moderate; 19-22 = good; doxycycline as a reference drug

InChI

InChI=1S/C50H34N4S2.Mo.2O/c51-40-23-19-31-10-1-5-14-36(31)45(40)47-38-16-7-3-12-33(38)21-25-42(47)53-49(35-27-29-55-30-35)50(44-18-9-28-56-44)54-43-26-22-34-13-4-8-17-39(34)48(43)46-37-15-6-2-11-32(37)20-24-41(46)52;;;/h1-30H,51-52H2;;;/b53-49+,54-50+;;;

TABSBMoInChI key

CGKRJICCAFQBHX-VQOQNKOZSA-N

TABSBMoSMILES

O=[Mo-4]123([N+](C(C=C4)=C(C5=C([NH2+]2)C=CC6=C5C=CC=C6)C7=C4C=CC=C7)=C(C(C8=CSC=C8)=[N+]1C9=C(C(C=CC=C%10)=C%10C=C9)C%11=C([NH2+]3)C=CC%12=C%11C=CC=C%12)C% 13=CC=CS%13)=O

LogP

0

CONCLUSION

Since their crystals have not been separated, we are unable to provide crystal structures for the corresponding compounds. It is feasible to represent all of the produced compounds as TABSBMo or

TABSBMoβs using the elemental and spectral research mentioned above. Antibacterial activity tests have been conducted on these substances to evaluate their biological activity. The present study demonstrates dioxin derivatives produced from the TABSB of Mo(VI). After reacting with 1,3-diketones, they produce macrocyclic compounds that regulate the geometrical shape of MoO_2(VI) centers. The octahedron surrounding Mo is distorted. Condensation of Schiff bases involves dioxomolybdenum(VI) cation in an ethanol medium using thenil and diamines. Tetradentate bonds are created between the metal ions and the azomethine nitrogen atoms in manufactured TABSB. The metal ion and ligand ratio is 1:1, according to analytical data. The produced compounds have been proposed to have deformed octahedral andsix-coordinated geometries and a mononuclear.

ACKNOWLEDGMENT

Authors extend their heartfelt gratitude tothe Board of Management, D.A-V. College, Kanpur, for their conceded support. The Council of Science and Technology, Uttar Pradesh, Lucknow, India, is kind enough to extend their financial support to embark on this journey.

Funding

This work was financially supported by the Council of Science and Technology, Uttar Pradesh, Lucknow, India (CST/CHEM/D-1426 dated 25 October 2023; Project ID-2192).

Conflict of Interest

Authors declare no competent financial interest.

REFERENCES

1. Healy, M.D.S.; Rest, A. J. Template reactions., *Advances Inorganic Chemistry and Radiochemistry.*, **1978**, *21*, 1-40,https://doi.org/10.1016/S0065-2792(08)60277-0
2. Sergienko, V.S.; Abramenko, V.L.; Gorbunova, Y.E. Dioxomolybdenum (VI) Complexes with R1-Substituted Salicylidene Allylimines (Hl n): Synthesis and Structure. Crystal Structure of $[MoO_2(L^1)_2](R_1=H)$., *Russian Journal of Inorganic Chemistry.,* **2018**, *63*, 28-33,https://doi.org/10.1134/S003602361801014X
3. Melson, G.A. Coordination Chemistry of Macrocyclic Compounds. Plenum Press, NY., **1979**.
4. Lindoy L.F.; Busch, D.H., *Preparative Inorganic Reactions.*, **1971**, *6*, 1.
5. Lindoy, L.F.; Busch, D.H. Metal ion-controlled syntheses of novel five-coordinate zinc and cadmium complexes containing a helical coordination geometry and their template reaction to form complexes of a pentadentate macrocyclic ligand., *Inorganic Chemistry.*, **1974**, *13*(10), 2494-2498,https://doi.org/10.1021/ic50140a037
6. Luo, X.F.; Hu, X.; Zhao, X.Y.; Goh, S.H.; Li, X.D. Miscibility and interactions in blends and complexes of poly(4-methyl-5-vinylthiazole) with proton-donating polymers., *Polymer.*, **2003**, *44*(18),5285-5291,https://doi.org/10.1016/S0032-3861(03)00578-0
7. Murthy, A.S.N.; Reddy, A.R. Electronic absorption spectroscopic studies of enolimine-ketoamine equilibria in Schiff bases., *Journal of Chemical Sciences.,* **1981**, *90*(6), 519-526,https://www.ias.ac.in/article/fulltext/jcsc/090/06/0519-0526
8. Razakantoanina, V.; Phung, N.K.P.; Jaureguiberry, G. Antimalarial activity of new gossypol derivatives., *Parasitology Research.,* **2000**, *86*(8), 665-668,https://doi.org/10.1007/pl00008549
9. Royer, R.E.; Deck, L.M.; Vander T.J.; Jagtm, Synthesis and anti-HIV activity of 1,1'-dideoxygossypol and related compounds., *Journal of Medicinal Chemistry.,* **1995**, *38*(13), 2427-2432,https://doi.org/10.1021/jm00013a018
10. Flack, M.R.; Pyle, R. G.; Mullen, N.M. Oral gossypol in the treatment of metastatic adrenal cancer., *Journal of Clinical Endocrinology Metabolism.*, **1993**, *76*, 1019-1024,https://doi.org/10.1210/jcem.76.4.8473376
11. Baumgrass, R.; Weiwad, M.; Erdmann, F. Reversible inhibition of calcineurin by the polyphenolic aldehyde, gossypol., *The Journal of Biological Chemistry.,* **2001**, *276*(51), 47914-47921,https://doi.org/10.1074/jbc.m103273200
12. Al-Shihri, A.S.M.; Abdel Fattah, H.M. Thermogravimetric and Spectroscopic characterization of trivalent lanthanide chelates with some Schiff base., *Journal of Thermal Analysis Calorimetry.,* **2003**, *71*(2), 643-649,https://doi.org/10.1023/A:1022880615841.

13. Raman, N.; Sakthivel, A.; Rajasekaran K. Synthesis and spectral characterization of antifungal sensitive Schiff base transition metal complexes., *Mycobiology.*, **2007**, *35*(3), 150-153,https://doi.org/10.4489/MYCO.2007.35.3.150
14. Creaven, B.S.; Czeglédi, E.; Devereux, M.; Enyedy, E.A.; Kia, A.F.A; Karcz, D.; Kellett, A.; McClean, S.; Nagy, N.V.; Noble, A.; Rockenbauer, A.; Szabó-Plánka, T.; Walshab, M. Biological activity and coordination modes of copper(II) complexes of Schiff base-derived coumarin ligands., *Dalton Transactions.*, **2010**, *39*, 10854-10865, https://doi.org/10.1039/c0dt00068j
15. Doctor, V. M.; Oro, J. Mechanism of non-enzymatic transition reaction between histidine and alphaoxoyglutaric acid., *Journal of Biochemistry.*, **1969**, *112*(5), 691-697, https://doi.org/10.1042/bj1120691
16. El-Gammal, O.A.; El-Reash, G.M.A.; Goama, H.E. Mononuclear Cr(III), Mn (II), and Fe(III) complexes derived from new ONO symmetrical flexible hydrazone: synthesis, spectral characterization, optical band gap and DFT computational study., *Letters in Applied NanoBioScience.*, **2019**, *8*(4), 743-753,https://doi.org/10.33263/LIANBS84.743753
17. Jarrahpour, A.; Khalili, D.; De Clercq, E.; Salmi, C.; Brunel, J.M. Synthesis, antibacterial, antifungal and antiviral activity evaluation of some new bis-Schiff bases of isatin and their derivatives., *Molecules.*, **2007**, *12*, 1720-1730, https://doi.org/10.3390/12081720
18. Bharti, S.K.; Patel, S.K.; Nath, G.; Tilak, R.; Singh, S.K. Synthesis, characterization, DNA cleavage and in vitro antimicrobial activities of copper(II) complexes of Schiff bases containing a 2,4-disubstituted thiazole., *Transition Metal Chemistry.,* **2010**, *35*, 917-925, https://doi.org/10.1007/s11243-010-9412-8.
19. Manjunatha, M.; Naik, V. H.; Kulkarni, A.D.; Patil, S.A. DNA cleavage, antimicrobial, antiinflammatory anthelmintic activities, and spectroscopic studies of Co(II), Ni(II), and Cu(II) complexes of biologically potential coumarin Schiff bases., *Journal of Coordination Chemistry.,* **2011**, *64*(24), 4264-4275, https://doi.org/10.1080/00958972.2011.621082
20. Dongfang, X.U.; Shuzhi, M.A.; Guangyinng, D.V.; Qizhuang, H.E.; Dazhi, S. Synthesis, characterization and anticancer properties of rare earth complexes with Schiff base and O-phenanthroline., *Journal of Rare Earths.,* **2008**, *26*(5), 643-647,https://doi.org/10.1016/S1002-0721(08)60153-2
21. Katiyar, S.; Rao, D.P.; Verma, N.K.; Gautam, A.K.; Singh, C.P.; Verma, A.; Gupta, G.P. Synthesis and Crystal Structure-Activity Studies and Possible Therapeutic Application of Diamine Conjugated Furil Schiff Base as Antibacterial Agent., *Chemistry Africa.,* **2024**, *7*(4), 1817-1828, 2024,https://doi.org/10.1007/s42250-023-00868-0
22. Rao, D.P.; Yadav, H.S.; Srivastava, A. cis-Dioxomolybdenum(VI) complexes with symmetrical tetradentate Schiff bases and their antibacterial activity., *Biointerface Research in Applied Chemistry.*, **2014**, *4*(1), 678-684, https://publons.com/wos-op/publon/56118929/
23. Yadava, A.K.; Yadav, H.S.; Yadava, U.S.; Rao, D.P. Synthesis, structure and characterization of oxovanadium(IV) Schiff base complexes with tetradentate macrocyclic ligands., *Biointerface Research in Applied Chemistry.,* **2012**, *2*(5), 424-431.
24. Uddin, N.; Rashid, F.; Ali S.; Tirmizi S.A.; Ahmad, I.; Zaib, S.;Zubair, M.; Diaconescu, P.L.; Tahir, M.N., Jamshed, I.; Haider, A. Synthesis, characterization, and anticancer activity of Schiff bases., *Journal of Biomolecular Structure and Dynamics.*, **2019**, *38*(11), 3246-3259,https://doi.org/10.1080/07391102.2019.1654924
25. Etain, S.E.H.; Abd El-Aziz, D.M.; Abd El-Zaher, E.H.; Ali, E.A. Synthesis spectral, antimicrobial and antitumor assessment of Schiff base derived from 2-aminobenzothiazol and its transition metal complexes., *Spectro Chim. Acta. Molecular and Biomolecular Spectroscopy*, A., **2011**, *79*(5), 1331-1337, https://doi.org/10.1016/j.saa.2011.04.064
26. Cozzi, P.G. Metal-Salen Schiff base complexes in catalysis: practical aspects., *Chemical Society Reviews.*, **2004**, *33*, 410–421,https://doi.org/10.1039/b307853c

27. Singh, R.K.; Kukrety, A.; Saxena, R.C.; Thakre, G.D.; Atray, N.; Ray, S.S. Novel triazine Schiff base-based cationic gemini surfactants: Synthesis and their evaluation as Antiwear, antifriction, and anticorrosive additives in polyol., *Industrial and Engineering Chemistry Research*., **2016**, *55*(9), 2520-2526,https://doi.org/10.1021/acs.iecr.5b04242
28. Sathya, N.; Raja, G.; Padma; Priya, N.; Jayabalakrishnan C. Ruthenium(II) complexes incorporating tridentate schiff base ligands: Synthesis, spectroscopic, redox, catalytic and biological properties., *Applied Organometallic Chemistry.,* **2010**, *24*(5), 366-373,https://doi.org/10.1002/aoc.1621
29. Arun, V.; Sridevi, N.; Robinson, P.P.; Manju, S.; Yusuff, K.K.M. Ni(II) and Ru(II) Schiff base complexes as catalysts for the reduction of benzene., *Journal of Molecular Catalysis A: Chemical*., **2009**, *304*(1-2), 191-198,https://doi.org/10.1016/j.molcata.2009.02.011
30. Segura, J.L.; Mancheño, M.J.; Zamora, F. Covalent organic frameworks based on Schiff-base chemistry: synthesis, properties and potential applications., *Chemical Society Review.,* **2016**, *45*, 5635-5671,https://doi.org/10.1039/c5cs00878f
31. Amer, S.; El-Wakiel, N.; El-Ghamry, H. Synthesis, spectral, antitumor and antimicrobial studies on Cu(II) complexes of purine and triazole Schiff base derivatives., *Journal of Molecular Structure.,* **2013**, *1049*, 326-335,https://doi.org/10.1016/j.molstruc.2013.06.059
32. Ohashi, M.; Koshiyama, T.; Veno, T.; Yanase, M.; Fujii, H.; Watanabe, Y. Preparation of artificial metalloenzymes by insertion of Chromium(III)Schiff base complexes in to apomyoglobin mutants., *Angewandte Chemie International Edition*., **2003**, *42*(9), 1005-1008, https://doi.org/10.1002/anie.200390256
33. Yadava, H.D.S.; Sengupta, S.K; Tripathi, S.C.Syntheses and spectroscopic studies on dioxouranium(VI), oxovanadium(IV) and oxozirconium(IV) complexes with tetradentate macrocyclic ligands., *Inorganica Chimica Acta*., **1987**, *128*, 1-6,https://doi.org/10.1016/S0020-1693(00)84685-X
34. Sergienko, V.S.; Abramenko, V.L.; Surazhskaya, M.D. Intracomplex Dioxomolybdenum (VI) Compounds with Alcoholimines of Aromatic o-Hydroxyaldehydes. Crystal Structure of 2-Hydroxynaphthylidene Monoethanolimine (H_2L) and Solvated Complex [$MoO_2(L)•C_5H_5N$]., *Russian Journal of Inorganic Chemistry*., **2020**, *65*, 495-501, https://doi.org/10.1134/S0036023620040166
35. Crans, D.C. Fifteen years of dancing with vanadium., *Pure and Applied Chemistry*., **2005**, *77*(9), 1407-1527,http://dx.doi.org/10.1351/pac200577091497
36. Bagherzadeh, M.; Amini, M.; Parastar, H.Synthesis, X-ray structure and oxidation catalysis of a oxido–peroxido molybdenum(VI) complex with a tridentate Schiff base ligand., *Inorganic Chemistry Communications.,* **2012**, *20*, 86-89,https://doi.org/10.1016/j.inoche.2012.02.023
37. Moradi-Shoeili, Z.; Zare.; M.; Bagherzadeh, M.; Kubicki, M.; Boghaei, D.M.Preparation and structure of zinc complexes containing pincer ligands and their application for Knoevenagel condensation in water., *Journal of Coordination Chemistry*., **2015**, *68*(2), 548-559, https://doi.org/10.1080/00958972.2014.978308
38. Bagherzadeh, M.; Amini, M.; Parastar, H. Synthesis, X-ray structure and oxidation catalysis of a oxido–peroxido molybdenum(VI) complex with a tridentate Schiff base ligand., *Inorganic Chemistry Communication.,* **2012**, *20*, 86-89,https://doi.org/10.1016/j.inoche.2012.02.023
39. Aziz, A.A.A.Synthesis, spectroscopic characterization, thermal studies, catalytic epoxidation and biological activity of chromium and molybdenum hexacarbonyl bound to a novel N_2O_2 Schiff base., *Journal of Molecular Structure*., **2010**, *979*(1-3), 77-85,https://doi.org/10.1016/j.molstruc.2010.06.004
40. Chakravarthy, R.D.; Suresh, K.; Ramkumar, V.; Chand, D.K.New chiral molybdenum complex catalyzed sulfide oxidation with hydrogen peroxide., *Inorganica Chimica Acta.,* **2011**, *376*(1), 57-63,https://doi.org/10.1016/j.ica.2011.05.033
41. Rayati, S.; Rafiee, N.; Wojtczak, A. cis-Dioxo-molybdenum(VI) Schiff base complexes: Synthesis, crystal structure and catalytic performance for homogeneous oxidation of olefins., *Inorganica Chimica Acta*., **2012**, *386*, 27-35, https://doi.org/10.1016/j.ica.2012.02.005

42. Rao, D.P. A review on versatile applications of novel Schiff bases and their metal complexes., *Letters in Applied NanoBioScience*., **2019**, *8*(4), 675-681.https://doi.org/10.33263/LIANBS84.675681
43. Pushie, M.J.; George, G.N., *Spectroscopic studies of molybdenum and tungsten enzymes. Coordination Chemistry Review.,* **2011**, *255*(9-10), 1055-1084,https://doi.org/10.1016/j.ccr.2011.01.056
44. Gautam, R.K.; Singh, C.P.; Prasad S.P.; Saxena, R.; Rao, D.P. Synthesis and antibacterial activity of novel molybdenum complexes with macrocyclic Schiff base derived from furanylethanedione., *Asian Journal of Chemistry*., **2019**, *31*, 2607-2612, https://doi.org/10.14233/ajchem.2019.22242
45. Rao, C.P.; Sreedhara, A.; Rao, P.V.; Verghese, M.B.; Rissanen, K.; Kolehmainen, E.; Lokanath, N.K.; Sridhar, M.A.; Prasad, J.S.Syntheses, structure, reactivity and species recognition studies of oxo-vanadium(V) and -molybdenum(VI) complexes., *Journal of the Chemical Society .,* **1998**, *14*, 2383-2394,https://doi.org/10.1039/A801226A
46. Hahn, R.; Herrmann, W.A.; Artens, G.R.J. Kleine, M. Biologically relevant metal coordination compounds: MoVIO$_2$ and nickel(II) complexes with tridentate aromatic Schiff bases., *Polyhedron*., **1995**, *14*(20-21), 2953-2960, https://doi.org/10.1016/0277-5387(95)00133-D
47. Mendel, R.R. Molybdenum: biological activity and metabolism., *Dalton Transaction*., **2005**, *21*, 3404-3409,https://doi.org/10.1039/B505527J
48. Sigel, A.; Sigel, H., Metal Ions in Biological Systems, Molybdenum and Tungsten: Their Roles in Biological Processes, Marcel Dekker, NY., **2002,** *39*.
49. Maurya, R.C.; Shukla, B.; Pandey, A.Synthesis, magnetic and spectral studies of some cis-dioxomolybdenum(VI) complexes derived from N,O- and N$_2$O$_2$- type Schiff bases., *Indian Journal of Chemistry*., **2002**, *41A*(3), 554-559,URI:http://hdl.handle.net/123456789/29016
50. Rousso, I.; Friedman, N.; Sheves, M.; Ottolenghi, M. pKa of the protonated Schiff base and aspartic 85 in the bacteriorhodopsin binding site is controlled by a specific geometry between the two residues., *Biochemistry.,* **1995**, *34*, 12059-12065, https://doi.org/10.1021/bi00037a049
51. Bassov, T.; Sheves, M. Alteration of pKa of the bacteriorhodopsin protonated Schiff base. A study with model compounds., *Biochemistry*., **1980**, *25*(18), 5249-5258, https://doi.org/10.1021/bi00366a040
52. Mimoum, H.; Roch, I.S.D.; Sajus, L. Epoxydation des olefines par les complexes peroxydiques covalents du molybdène-VI., *Tetrahedron*., **1970**, *26*(1), 37-50,https://doi.org/10.1016/0040-4020(70)85005-0
53. Conte, V.; Furia, F.D. Catalytic oxidations with hydrogen peroxide as oxidant, Kluwer Academic Publisher, Berlin, **1992**.
54. Mimoum, H.; Saussine, L.; Daire, E.; Postel, M.; Fisher, J.; Weiss, R. Vanadium(V) peroxy complexes. New versatile biomimetic reagents for epoxidation of olefins and hydroxylation of alkanes and aromatic hydrocarbons., *Journal of American Chemistry Society.,* **1983**, *105*(10), 3101-3110,https://doi.org/10.1021/ja00348a025
55. Nair, M.L.H.; Thankamani, D. Synthesis and characterization of oxomolybdenum (V) and dioxomolybdenum (VI) complexes with Schiff base derived from isonicotinoylhydrazide., *Indian J. of Chem.,* **2009**, *48A*(9), 1212-1218, URI:http://hdl.handle.net/ 123456 789/6010.
56. Garner, G.D. Molybdenum, special topics in Comprehensive Coordination Chemistry. Wilkinson G, Ed., Pergamon press., *Oxford*., **1987**, *6*, 1421.
57. Niasari, M.S.; Davar, F.; Bazarganipour, M. Synthesis, characterization and catalyticoxidation of para-xylene by a manganese(III) Schiff base complex on functionalized multi-wall carbon nanotubes (MWNTs)., *Dalton Transactions*., **2010**, *39*, 7330-7337,https://doi.org/10.1039/B923416K
58. Ambroziak, K.; Beleck, R.M.; He, Y.; Saha, B.; Sherrington, D.C. Investigation of batch alkene epoxidations catalyzed by polymer-supported Mo(VI) complexes., *Industrial and Engineering Chemistry Research*., **2009**, *48*(7), 3293-3302,https://doi.org/10.1021/ie801171s
59. Vogel, A.I. A Text book of quantitative Inorganic analysis 4th ed., Longmans Green Co. Ltd., London., **1978**.

60. Vogel, A.I. A Text book of practical organic chemistry 4th ed., Longmans Green Co. Ltd., London., **1978**.
61. Simmons, A. Practical medical microbiology 14th ed, Churchill Livingston, *Edinberg*., **1996**, *11*, 163.
62. Collee, J.G.; Duguid, J.P.; Frase, A.G.; Marmion, B.D. Practical medical microbiology, Churchill Livingstone, New York, **1989**.
63. Nag, P.; Sharma, D. Synthesis, characterization and anticandidal activity of dioxomolybdenum(VI) complexes of the type $[MoO_2\{ON{=}C(CH_3)Ar\}_2]$ and $[MoO_2\{OC(R)CHC(R'){=}NC_6H_5\}_2]$. Heliyon **2019**, *5*(5), E01729, https://doi.org/10.1016/j.heliyon. 2019.e01729
64. Rana, V.B.; Singh, P.; Singh, D.P.; Teotia, M.P.Trivalent chromium, manganese, iron and cobalt chelates of a tetradentate N6 macrocyclie ligand., *Transition Metal Chemistry*., **1982**, *7*, 174-177,https://doi.org/10.1007/BF01035836
65. Chandra, S.; Sharma, K.K. Synthesis and characterization of copper(II) complexes of a macrocyclic ligand., *Transition Metal Chemistry*., **1983**, *8*, 1-3,https://doi.org/10.1007/BF00618784
66. Malik, W.U.; Bembi, R.; Singh, R. Preparation and characterisation of some new 12- and 14-membered dibenzotetraaza macrocyclic complexes of iron(III)., *Inorganica Chimica Acta*., **1983**, *68*, 223-228,https://doi.org/10.1016/S0020-1693(00)88965-3
67. Głowiak, T.; Jerzykiewicz, L.; Sobczak, J.M.; Ziółkowski, J.J. New insights into the chemistry of oxomolybdenum(VI) complexes with N-salicylidene-2-aminoethanol., *Inorganica Chimica Acta*., **2003**, *356*, 387-392,https://doi.org/10.1016/S0020-1693(03)00301-3
68. Ferraro, J.R. Low frequency vibrations of inorganic and coordination compounds. Plenum, New York, **1971**.
69. Dyer, J.R. Applications of absorption spectroscopy of organic compounds. Prentice-Hall, Inc., Englewood Cliffs, NJ, **1965**.
70. Singh, S.; Yadav, H.S.; Yadava, A.K.; Rao, D.P. Synthesis and characterization of oxovanadium(IV) complexes with tetradentate Schiff base ligands having thenil as precursor molecule., *Current Research in Chemistry.,* **2011**, *3*, 106-113,https://doi.org/10.3923/crc.2011.106.113
71. Willis, L.J.; Loehr, T.M.; Miller, K.F.; Bruce, A.E.; Stiefel, E.I.Raman and infrared spectroscopic studies of dioxomolybdenum(VI) complexes with cysteamine chelates., *Inorganic Chemistry*., **1986**, *25*, 4289-4293,https://doi.org/10.1021/ic00243a045
72. Ceylan, B.I.; Kurt, Y.D.; Ulkuseven, B. Synthesis and characterization of new dioxomolybdenum(VI) complexes derived from benzophenone-thiosemicarbazone (H_2L). Crystal structure of $[MoO_2L(PrOH)]$., *Journal of Coordination Chemistry*., **2009**, *62*, 757-766, https://doi.org/10.1080/00958970802339669
73. S.N.Rao, K.N. Munshi, N.N. Rao, M.M. Bhadbhade, E. Suresh. Synthesis, spectral and X-ray structural characterization of [cis-MoO_2(L)(solv)](L = salicylidene salicyloyl hydrazine) and its use as catalytic oxidant., *Polyhedron*., **1999**, *18*, 2491-2497,https://doi.org/10.1016/S0277-5387(99)00139-4
74. El-Medani, S.M.; Aboaly, M.M.; Abdalla, H.H.; Ramadan, R.M. Reactions of Group 6 Metal Carbonyls with Salicylaldehyde Hydrazone., *Spectroscopy Letter*., **2004**, *37*(6), 619-632, https://doi.org/10.1081/SL-200037610
75. Zhu, X.W. Synthesis, crystal structures and catalytic property of dioxomolybdenum(VI) complexes derived from tridentate Schiff bases., *Acta Chimica Slovenica*., **2018**, *65*, 939-945,https://doi.org/10.17344/acsi.2018.4607
76. Maurya, R.C.; Chourasia, J.; Martin, M.H.; Roy, S.; Sharma, A.K.; Vishwakarma, P. Dioxomolybdenum (VI) chelates of bioinorganic, catalytic, and medicinal relevance: Studies on some cis-dioxomolybdenum(VI) complexes involving O, N-donor 4-oximino-2-pyrazoline-5-one derivatives., *Arabian Journal of Chemistry.,* **2015**, *8*(3), 293-306,https://doi.org/10.1016/j.arabjc.2011.01.010
77. Wang, X.; Zhang, X.M.; Liu, H.X. Synthesis, characterization and crystal structure of cis-dioxomolybdenum(VI) complexes of the Schiff base Girard reagent (T) salt., *Journal of Coordination Chemistry*., **1994**, *33*, 223-228, https://doi.org/10.1080/00958979408024280

78. Mahmoudi, H.; Bagherzadeh, M.; Ataie, S.; Kia, R.; Heydar Moravej, S.; Zare, M.; Raithby, P.R.; Ferlin, F.; Vaccaro, L. Synthesis and X-ray crystal structure of a molybdenum(VI) Schiff base complex: Design of a new catalytic system for sustainable olefin epoxidation., *Inorganica Chimica Acta*., **2020**, *511*, 119775, https://doi.org/10.1016/j.ica.2020.119775
79. Rao, D.P.; Yadav, H.S.; Yadava, A.K.; Singh, S.; Yadav, U.S.Syntheses and spectroscopic studies on macrocyclic complexes of dioxomolybdenum(VI) with furil as precursor., *E-Journal of Chemistry*., **2012**, *9*, 497-503, https://doi.org/10.1155/2012/205123
80. Cotton, F.A.; Wilkinson, G.; Murillo, C.A.; Bochmann, M., *Advanced Inorganic Chemistry*. 6thed., Wiley, New York., **1999**, *18*, 944-947.
81. Nakamoto, K. Infrared and Raman Spectra of inorganic and co-ordination compounds. New York: Wiley, **1978**, https://doi.org/10.1002/0470027320.s4104
82. Gehrke, H.; Veal, J. Acetylacetonate complexes of molybdenum(V) and molybdenum(VI)., *Inorganica Chimica Acta.,* **1969**, *3*, 623-627,https://doi.org/10.1016/S0020-1693(00)92563-5
83. Yadav, H.S. Synthesis of spectroscopic studies of oxovanadium(IV) complexes with 16- and 18-membered macrocyclic ligands., *Polyhedron.,* **1993**, *12*, 313-317,https://doi.org/10.1016/S0277-5387(00)81729-5
84. Rao, D.P.; Yadav, H.S.; Yadava, A.K.; Singh, S.; Yadav, U.S. In-situ preparation of macrocyclic complexes of dioxomolybdenum(VI) involving a heterocyclic precursor., *Journal of Coordination Chemistry*., **2011**, *64*, 293-299, https://doi.org/10.1080/0095 8972.2010.544037
85. Sakata, K.; Kuroda, M.; Yanagida, S.; Hashimoto, M. Preparation and spectroscopic properties of oxovanadium(IV) and dioxomolybdenum(VI) complexes with tetraaza[14] annulenes containing pyridine rings., *Inorganica Chimica Acta*., **1989**, *156*, 107-112,https://doi.org/10.1016/S0020-1693(00)90375-X
86. Gautam, R.K.; Singh, C.P.; Kumar, D.; Rao, D.P. New Insights into the Chemistry of cis-Dioxomolybdenum(VI) Schiff base complexes with macrocyclic ligands., *Chemical Science Transactions*., **2019**, *8*(4), 467-476,https://doi.org/10.7598/cst2019.1594
87. Garg, R.; Saini, M.K.; Fahmi, N.; Singh, R.V. Spectroscopic and biochemical studies of some manganese(II), oxovanadium(V) and dioxovanadium(VI) complexes S/O and N donor agents synthesized under microwave conditions., *Transition Metal Chemistry*., **2006**, *31*, 362-367,https://doi.org/10.1007/s11243-005-0001-1
88. Gautam, R.K.; Singh, C.P.; Saxena, R.; Rao, D.P. Synthesis and studies of some cis-MoO_2(VI) complexes with nitrogen donor macrocyclic ligands., *European Chemical Bulletin*., **2019**, *8*, 387-393, http://dx.doi.org/10.17628/ecb.2019.8.387-393
89. Kahroic, E.; Molcanov, K.; Tusek-Bozic, L.; Kojic-Prodic, B. New complexes of Mo(V) with Schiff bases: Crystal structure of butylammonium di-μ-oxo-μ-acetato-bis[(N-butylsalicylideniminato-N,O) oxomolybdenum(V)] benzene, acetic acid solvate., *Polyhedron.,* **2006**, *25*(12), 2459-2464, https://doi.org/10.1016/j.poly.2006.02.008
90. Ballhausen, C.J.; Gray, H.B. The electronic structure of the vanadyl ion., *Inorganic Chemistry*., **1962**, *1*, 111-122,https://doi.org/10.1021/ic50001a022